**Ancient Monuments Laboratory**
**Report 16/91 (Parts 1 and 2)**

# Part 1: The Medieval Burials from the Blackfriars Friary, School Street, Ipswich, Suffolk (Excavated 1983-5).

## S. A. Mays

**See also part II: Appendix: data for individual burials.**

# THE MEDIEVAL BURIALS FROM THE BLACKFRIARS FRIARY, SCHOOL STREET, IPSWICH, SUFFOLK (EXCAVATED 1983-1985).

**S. A. Mays**

**Summary**

250 burials (148 male adults, 64 female adults, 14 unsexed adults and 24 juveniles) interred between 1263 and 1538 are examined. The material was excavated in 1983-5, from the site of the Blackfriars Friary, School Street, Ipswich. The burials represent interments within the friary complex. A study of the effects of preservation and recovery factors on the assemblage is carried out. Comparison between this group and other archaeological assemblages suggests a change in cranial form in East Anglia about the time of the Norman Conquest. Pathologies include possible cases of rheumatoid arthiritis, syphilis (which a high precision radiocarbon date indicates predates 1493), tuberculosis, leprosy, Paget's disease and weapon injuries. Despite the above it seems likely that this was a fairly privileged group in terms of diet and health.

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# THE MEDIAEVAL BURIALS FROM THE BLACKFRIARS FRIARY, SCHOOL STREET, IPSWICH (EXCAVATED 1983-85)

## Introduction to the site

Bones from 250 inhumations of Mediaeval date are studied. They represent benefactors and friars buried within the Blackfriars' complex (Fig. 1). The numbers of interments studied from the various locations within the friary are shown in Table 1.

Table 1: Location of burials studied

| Location | Number |
|---|---|
| Church Nave | 183 |
| Church Choir | 18 |
| East Range of Cloister | 13 |
| North Range of Cloister | 11 |
| Church Walking Place | 8 |
| South Range of Cloister | 7 |
| Chapter House | 7 |
| To South of Nave | 3 |

The friary was founded in 1263 and was suppressed in 1538 (Page 1975: 122-123). Although there was much inter-cutting of graves, more precise dating of particular burials or groups of burials within this 275 year period was not possible. Human bones were also uncovered during alterations to the brewery which lay on the north side of the site; it seems probable that they were derived from a cemetery, associated with the friary, to the north of the friary church (Blatchly & Wade 1980). It is probable that not all the buildings of the friary complex were excavated; documentary evidence (Gilyard-Beer 1980) suggests the existence of a second cloister to the south of the excavated area: perhaps further burials were located here. Names of 15 individuals buried in the friary are known (Palmer 1887, 1891), but in no case was it possible to associate names with particular skeletons. The friary buildings partially overlay a late Anglo-Saxon (10th-11th century) cemetery; bones from this burial ground formed the subject of a previous report (Mays 1989).

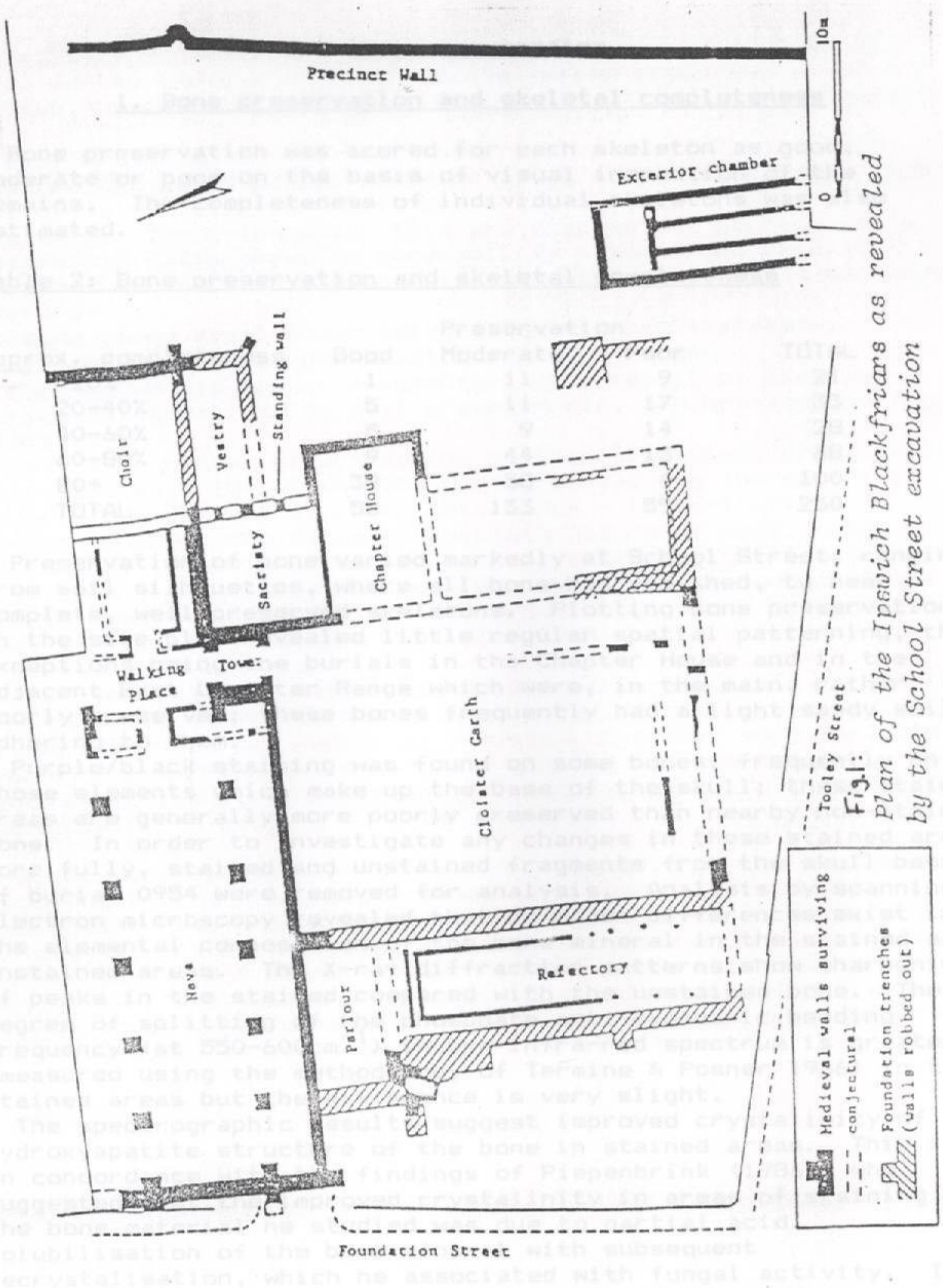



*Fig. 1 Plan of the Ipswich Blackfriars as revealed by the School Street excavation*

## The human remains

### *1. Bone preservation and skeletal completeness*

Bone preservation was scored for each skeleton as good, moderate or poor on the basis of visual inspection of the remains. The completeness of individual skeletons was also estimated.

Table 2: Bone preservation and skeletal completeness

| | Preservation | | | |
|---|---|---|---|---|
| Approx. completeness | Good | Moderate | Poor | TOTAL |
| <20% | 1 | 11 | 9 | 21 |
| 20-40% | 5 | 11 | 17 | 33 |
| 40-60% | 5 | 9 | 14 | 28 |
| 60-80% | 9 | 44 | 15 | 68 |
| 80+ | 38 | 58 | 4 | 100 |
| TOTAL | 58 | 133 | 59 | 250 |

Preservation of bone varied markedly at School Street, ranging from soil silhouettes, where all bone had vanished, to near complete, well preserved skeletons. Plotting bone preservation on the site plan revealed little regular spatial patterning, the exceptions being the burials in the Chapter House and in the adjacent East Cloister Range which were, in the main, rather poorly preserved; these bones frequently had a light sandy soil adhering to them.

Purple/black staining was found on some bones, frequently on those elements which make up the base of the skull; these stained areas are generally more poorly preserved than nearby non-stained bone. In order to investigate any changes in these stained areas more fully, stained and unstained fragments from the skull base of burial 0954 were removed for analysis. Analysis by scanning electron microscopy revealed that no major differences exist in the elemental composition of the bone mineral in the stained and unstained areas. The X-ray diffraction patterns show sharpening of peaks in the stained compared with the unstained bone. The degree of splitting of the phosphate anti-symmetric bending frequency (at 550-600cm-1) in the infra-red spectrum is greater (measured using the methodology of Termine & Posner 1966) in the stained areas but the difference is very slight.

The spectrographic results suggest improved crystalinity of the hydroxyapatite structure of the bone in stained areas. This is in concordance with the findings of Piepenbrink (1986), who suggested that the improved crystalinity in areas of staining on the bone material he studied was due to partial acid solubilisation of the bone mineral with subsequent recrystalisation, which he associated with fungal activity. It may well be that such an explanation is pertinent here - the poor preservation of bone in the stained areas is consistent with localised increased acidity (Gordon & Buikstra 1981). The reasons why stained areas tend to be located on the bones which make up the base of the skull are unclear, but if the suggestion that fungi are involved is correct, then it may be that the microenvironment in this area particularly favoured fungal activity.

Perhaps decomposition products accumulated in this area during the putrefaction of the corpse producing an acidic milieu, which tends to favour fungi over other micro-organisms.

Many graves inter-cut, and when a grave was cut by a later feature the parts of the skeleton lying nearest the later feature are often a little less well preserved than the rest of the skeleton. The reasons for this are obscure but perhaps it is related to differences in permeability between the natural, undisturbed soil and the more loosely packed fill of a man-made feature.

There is no significant association between skeletal completeness or bone preservation and age or sex.

Many bones are rather fragmentary as a result of breakage during interment due to soil pressure etc, and breakage during storage.

The large number of graves cut by later features, principally other graves - 104 of the 250 graves containing the material under study are cut by later interments - is partially responsible for the rather incomplete nature of many of the skeletons. However a chi-square test shows a significant (at the 0.1% level) association between bone preservation and skeletal completeness, suggesting that destruction of bones by aggressive soil conditions is also a significant factor in determining skeletal completeness.

The overall preservation of the Blackfriars burials is fairly similar to that of the Anglo-Saxon School Street skeletons, but preservation of the Mediaeval burials was rather more variable. Skeletal completeness is markedly greater for the Friary burials, reflecting the greater damage suffered by the Saxon inhumations as a result of cutting of later features.

A skeletal element was scored as present if it was represented by a complete or incomplete bone. The results, for adults (defined in the present work as those thought to be aged 18 years or over at death) only, and for the whole assemblage, are shown in Tables 3 and 4 respectively. In the table for adults (of which there are 226) the representation of each skeletal element, expressed as a percentage of that expected if all burials were represented by complete skeletons, is also given.

Table 3: Representation of skeletal elements (adults only)

| Skeletal element | No present | % of expected |
|---|---|---|
| Skull | 186 | 82.3 |
| Mandible | 164 | 72.6 |
| Hyoid | 37 | 16.4 |
| Cervical vertebrae | 876 | 55.4 |
| Thoracic vertebrae | 1836 | 67.7 |
| Lumbar vertebrae | 823 | 72.9 |
| Sacrum | 175 | 77.4 |
| Sternum | 134 | 59.3 |
| L ribs | 1205 | 44.4 |
| R ribs | 1139 | 42.0 |
| L clavicle | 169 | 74.8 |
| R clavicle | 158 | 69.9 |
| L scapula | 178 | 78.8 |
| R scapula | 173 | 76.5 |
| L humerus | 185 | 81.4 |
| R humerus | 184 | 81.4 |
| L radius | 183 | 81.0 |
| R radius | 187 | 82.8 |
| L ulna | 181 | 80.1 |
| R ulna | 190 | 84.1 |
| L carpals | 722 | 40.0 |
| R carpals | 810 | 44.9 |
| L metacarpals | 747 | 66.1 |
| R metacarpals | 790 | 69.9 |
| L hand phalanges | 944 | 29.8 |
| R hand phalanges | 1073 | 33.9 |
| Total hand phalanges | 2571 | 40.6 |
| L pelvis | 188 | 83.2 |
| R pelvis | 190 | 84.1 |
| L femur | 196 | 86.7 |
| R femur | 197 | 87.2 |
| L patella | 120 | 53.1 |
| R patella | 121 | 53.5 |
| L tibia | 200 | 88.5 |
| R tibia | 193 | 85.4 |
| L fibula | 180 | 79.6 |
| R fibula | 178 | 78.9 |
| L calcaneus | 188 | 83.2 |
| R calcaneus | 189 | 83.6 |
| L talus | 185 | 81.9 |
| R talus | 184 | 81.4 |
| L tarsals* | 757 | 67.0 |
| R tarsals* | 787 | 69.6 |
| L metatarsals | 854 | 75.6 |
| R metatarsals | 856 | 75.8 |
| L foot phalanges | 496 | 15.7 |
| R foot phalanges | 554 | 17.5 |
| Total foot phalanges | 1352 | 21.4 |

L=left R=right U=unknown side *=excluding talus and calcaneus

Table 4: Representation of skeletal elements (all burials)

| Skeletal element | No present |
|---|---|
| Skull | 207 |
| Mandible | 184 |
| Hyoid | 37 |
| Cervical vertebrae | 932 |
| Thoracic vertebrae | 1972 |
| Lumbar vertebrae | 882 |
| Sacrum | 191 |
| Sternum | 142 |
| L ribs | 1304 |
| R ribs | 1235 |
| L clavicle | 185 |
| R clavicle | 173 |
| L scapula | 193 |
| R scapula | 192 |
| L humerus | 203 |
| R humerus | 205 |
| L radius | 200 |
| R radius | 207 |
| L ulna | 199 |
| R ulna | 207 |
| L carpals | 758 |
| R carpals | 850 |
| L metacarpals | 801 |
| R metacarpals | 844 |
| L hand phalanges | 1003 |
| R hand phalanges | 1140 |
| Total hand phalanges | 2726 |
| L pelvis | 208 |
| R pelvis | 210 |
| L femur | 219 |
| R femur | 219 |
| L patella | 126 |
| R patella | 126 |
| L tibia | 221 |
| R tibia | 215 |
| L fibula | 197 |
| R fibula | 194 |
| L calcaneus | 203 |
| R calcaneus | 203 |
| L talus | 199 |
| R talus | 199 |
| L tarsals* | 806 |
| R tarsals* | 836 |
| L metatarsals | 918 |
| R metatarsals | 919 |
| L foot phalanges | 523 |
| R foot phalanges | 589 |
| Total foot phalanges | 1439 |

L=left R=right U=unknown side *=excluding talus and calcaneus

By comparison with the Anglo-Saxon cemetery all skeletal elements are better represented among the Blackfriars burials: 21118 bones were identified from 226 adults; the corresponding figures for the Anglo-Saxon cemetery are 4401 bones from 74 adults. However the pattern of relative representation of the different skeletal elements is remarkably similar in the two assemblages; this supports the suggestion that the lesser completeness of the Anglo-Saxon skeletons is due to random destruction of parts of these skeletons by the cutting of later features.

Most bones are well represented at the Blackfriars, particularly the longbones; only the ribs, hyoid, carpals, and hand and foot phalanges are represented by less than 50% of expected values based on complete skeletons.

It was argued above that destruction of bones during the period of interment by physical, chemical and biological agents is likely to be significant factor in determining skeletal completeness. In order to investigate this further, relative representation of skeletal elements in well preserved (N=51) and poorly preserved (N=55) adult skeletons are compared. Table 5 shows the ratio (expressed as a percentage) of the percentage of expected totals for each skeletal element in poorly preserved to those in well preserved skeletons.

Table 5: Representation of skeletal elements in poorly preserved divided by representation in well preserved skeletons.

| Skeletal element | (Percentage of expected in poorly pres indivs / Percentage of expected in well pres indivs) x100 |
|---|---|
| Mandible | 105.5 |
| Left tibia | 100.8 |
| Skull | 99.2 |
| Left calcaneus | 97.1 |
| Left talus | 97.1 |
| Right talus | 95.0 |
| Left femur | 94.8 |
| Right tibia | 92.7 |
| Right femur | 90.9 |
| Left patella | 89.0 |
| Right calcaneus | 88.5 |
| Right radius | 86.6 |
| Left ulna | 85.8 |
| Right metatarsals | 85.8 |
| Right humerus | 84.5 |
| Left humerus | 82.4 |
| Right tarsals | 82.2 |
| Right pelvis | 80.4 |
| Left metatarsals | 79.5 |
| Right ulna | 78.6 |
| Left radius | 77.2 |
| Left fibula | 75.9 |
| Left pelvis | 74.3 |
| Right fibula | 73.7 |
| Right patella | 72.9 |

| Skeletal element | Percentage of expected in poorly pres indivs x100<br>Percentage of expected in well pres indivs |
|---|---|
| Left tarsals | 70.4 |
| Left scapula | 66.0 |
| Sacrum | 65.4 |
| Left clavicle | 64.7 |
| Right scapula | 61.8 |
| Lumbar vertebrae | 55.4 |
| Right metacarpals | 55.4 |
| Right clavicle | 54.2 |
| Left metacarpals | 52.2 |
| Total foot phalanges | 50.2 |
| Thoracic vertebrae | 48.2 |
| Left carpals | 39.3 |
| Total hand phalanges | 39.1 |
| Right carpals | 36.4 |
| Sternum | 34.8 |
| Cervical vertebrae | 34.3 |
| Hyoid | 23.1 |
| Right ribs | 22.7 |
| Left ribs | 22.4 |

It could be argued that excavators tend to be rather less careful when excavating a skeleton which is clearly poorly preserved than one which appears well preserved; had this been the case at Ipswich this factor would clearly affect the relative representation of the various skeletal elements in well and poorly preserved skeletons. At the Ipswich Blackfriars site permanent teeth are little affected by preservation factors, generally being whole even in poorly preserved individuals; thus it is argued that investigation of the recovery rates of loose permanent teeth from poorly preserved and well preserved adult skeletons might illuminate any differences in the care with which the inhumations were excavated. Calculations involving estimations of the proportions of loose teeth recovered in well and poorly preserved skeletons failed to support the hypothesis that excavation of poorly preserved skeletons was less careful than that of well preserved ones.

The entries in Table 5 are arranged in order of percentage of expected in poorly preserved individuals divided by percentage of expected in well preserved individuals. Thus the further down the table a skeletal element lies the greater the deficit in its numbers in poorly preserved compared with well preserved skeletons, that is, the greater its vulnerability to destruction in the soil. Those elements least affected seem to be the skull, mandible, the large long-bones of the appendicular skeleton, pelvic bones, tali, calcanei and metatarsals. This is much as might be anticipated on the basis of the strength and relative cortical bone content of these bones. Conversely those most affected by preservation factors tend to be those with high proportions of cancellous bone, for example the vertebrae, sternum and ribs. Among the vertebrae the lumbar are the least, and the cervical the most affected by soil erosion, as expected given their relative strength and robusticity. It has been claimed (Waldron 1987) that under-representation of the small bones of the hands and feet in skeletal collections from archaeological sites is largely due to their being overlooked during excavation. However the present data show that both the carpals and hand phalanges are very much less frequent in poorly preserved material, implying that factors operating in the soil resulted in their destruction (or damaged them sufficiently to render them unidentifiable) and hence were an important cause of their fairly low level overall. Foot phalanges seem rather less affected by preservation factors than hand phalanges, but despite this are present in rather smaller quantities in the assemblage as a whole. It seems highly probable that this is due to differential recovery - more of the smaller foot phalanges were missed in excavation. The patellae seem little affected by preservation factors but are under-represented in the assemblage as a whole compared with bones of similar size and strength (e.g. tali and calcanei). This would seem to imply poor recovery as a factor in their under-representation, surprising in view of their fairly large size.

### *2. The demographic composition of the assemblage*

*(a) Determination of age and sex*

Sex is determined using dimorphic aspects of the pelvis and skull. It is not generally feasible reliably to determine sex in juveniles from their bones.

For individuals aged under about 15 years dental development (Ubelaker 1978: Fig. 62) is used to estimate age. When dental material was not available age is estimated from long-bone lengths using the formulae of Scheuer et al. (1980) for foetal and perinatal material and, for older children, using comparisons with long-bone lengths in children in the assemblage for whom dental age could be determined. For adolescents and young adults epiphysial fusion (Workshop of European Anthropologists 1980: Fig. 6) is used as an age indicator.

The principal method used to estimate age at death in adults (those thought to be aged 18 years or over at death) is dental attrition, a technique which has been shown to be fairly reliable in a variety of populations both living and dead. Insufficient immature individuals are present to calibrate the rate of attrition as recommended by Miles (1963), however research by Brothwell (1963) shows that it is probable that the rate of attrition did not change markedly in British populations from Neolithic to Mediaeval times; he was able to derive standards relating attrition stages to age at death (Brothwell 1981: Fig. 3.9). These standards are used in age estimation for the Ipswich adults.

The closure of the skull sutures (Perizonius 1984) is also taken into account, as is the state of the pubic symphyses (Suchey et al. 1987, 1988).

Table 6: Composition of the juvenile part of the assemblage by age and sex

| | 0<x<2 | 2<x<4 | 4<x<6 | 6<x<8 | 8<x<10 | 10<x<12 | 12<x<14 | 14<x<16 | 16<x<18 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Probably male | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 3 |
| Female | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Probably female | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Unsexed | 5 | 2 | 3 | 2 | 2 | 4 | 0 | 1 | 0 | 19 |
| Total | 5 | 2 | 3 | 2 | 3 | 5 | 0 | 1 | 3 | 24 |

Table 7: Composition of the adult part of the assemblage by age and sex

| | 18<x<25 | 25<x<35 | 35<x<45 | 45<x<55 | 55+ | ADULT | TOTAL |
|---|---|---|---|---|---|---|---|
| Male | 19 | 24 | 39 | 16 | 24 | 19 | 141 |
| Probably male | 1 | 3 | 2 | 0 | 0 | 1 | 7 |
| Female | 9 | 10 | 12 | 4 | 15 | 8 | 58 |
| Probably female | 0 | 3 | 1 | 0 | 0 | 2 | 6 |
| Unsexed | 0 | 1 | 2 | 0 | 1 | 10 | 14 |
| Total | 29 | 41 | 56 | 20 | 40 | 40 | 226 |

Note: henceforth probable males and probable females are, unless stated, included in the totals for adult "males" and "females".

Table 8: Mean age at death for adults

| Males | Females | All adults |
|---|---|---|
| 40.5 | 41.5 | 40.8 |

Of the 250 interments studied in the present work, 89 showed evidence for burial in a coffin, in the form of traces of wood fragments or coffin staining and/or the presence of iron nails. There is no association between presence of a coffin and the sex or age of the individual.

The position of the arms of each skeleton was noted on excavation and classified as: placed across the stomach or chest, placed across the pelvis or abdomen, or placed by the sides. Of the 193 interments studied for which the position of both arms could be recorded, in 173 cases the left and right arms were positioned in a symmetrical manner. The variation in arm position with respect to gender for those adults whose arms were positioned symmetrically is shown in Table 9.

Table 9: Arm position in male and female adult burials

| | Males | Females |
|---|---|---|
| Both arms across chest/stomach | 21* | 3# |
| Both arms across the pelvis/abdomen | 16* | 5* |
| Both arms by sides of body | 66+ | 44* |

*=includes 1 case in which sex could not be determined with certainty +=includes 2 cases in which sex could not be determined with certainty #=includes 3 cases in which sex could not be determined with certainty.

A chi-square test indicates that the association between arm position and sex in adults is significant at the 5% level. The data presented in Table 9 indicate that this is primarily a reflection of the fact that most interments with their arms across the chest/stomach area are male; indeed of the 3 interments buried in this manner which were classified as female indications of gender from the bones were somewhat ambiguous - all were sexed as "?females" - no certain females were buried in this position.

A significant association exists between burial in a coffin and asymmetry in arm position. During the act of interment any slight bumps which the coffin might receive could cause minor changes in the position of the corpse within; in addition the void space above the corpse in a coffined burial allows minor changes in corpse position during decomposition. It may thus be that interments showing asymmetry in arm position do so as a result of accident rather than design.

The difference in the numbers of male and female adults (148 males, 64 females) is significant at the 5% level. This sexual imbalance is consistent with findings from other Friary sites.

Table 10: Comparisons in sexual composition of Friary assemblages

| Site | M:F ratio (adults) | N | Reference |
|---|---|---|---|
| Oxford Greyfriars | 47:1 | 48 | Harman (1985) |
| Leicester Austin Friars | 15:1 | 16 | Stirland (1981) |
| Guildford Blackfriars | 6.3:1 | 80 | Henderson (1984a) |
| Oxford Blackfriars | 5.3:1 | 63 | Harman (1985) |
| Beverley Blackfriars | 4:1 | 10 | Dawes (1987) |
| Ipswich Whitefriars | 3:1 | 12 | Mays (1991) |
| Northampton Greyfriars | 2.5:1 | 14 | Griffiths (1978) |
| Chester Blackfriars | 2.4:1 | 34 | West (1990) |
| Ipswich Blackfriars | 2.3:1 | 212 | - |
| Carlisle Blackfriars | 1.8:1 | 145 | Henderson (1984b) |
| Chelmsford Blackfriars | 1.5:1 | 108 | Bayley (1975) |
| Hartlepool Greyfriars | 1.2:1 | 122 | Birkett (1986) |

Sexing of adults from skeletal remains has been shown to be highly reliable (e.g. Meindl et al. 1985), hence these figures cannot be explained by systematic sexing bias. It would seem logical to argue that the sex imbalance is due to the burials of friars increasing the numbers of males.

Table 11: Location of sexed adult burials

| Location | Males | Females | Unsexed |
|---|---|---|---|
| Church Choir | 8 | 5 | 0 |
| Chapter House | 5 | 0 | 2 |
| Church Nave | 110 | 53 | 8 |
| Church Walking Place | 6 | 2 | 0 |
| East Cloister | 8 | 3 | 2 |
| North Cloister | 8 | 1 | 1 |
| South Cloister | 1 | 0 | 1 |
| To South of Nave | 2 | 0 | 0 |

Female burials are found in all locations within the friary buildings save the Chapter House and the south range of the cloister, indicating that burials of layfolk occurred in all locations within the friary buildings, except possibly these two. Seven burials were received from the south range of the cloister, 1 male adult, 1 unsexed adult, 2 male juveniles and 3 unsexed juveniles, but due to the small numbers no firm conclusions can be reached. It has been suggested (Loader nd) that the burials in the Chapter House may be exclusively of religious, and the skeletal evidence (all burials are adult, 5 males, 2 unsexed) is consistent with this, although again numbers are rather small.

In all locations in the friary complex males outnumber females. If the hypothesis, above, that the sex imbalance, observed at Ipswich Blackfriars, and other Friary sites, is due to burials of friars then it would seem that at Ipswich, other than perhaps in the locations discussed above, burials of friars were not segregated from those of lay benefactors. (That burials of friars and layfolk need not be segregated is consistent with evidence from a collection of wills of individuals buried at 28 Blackfriars friaries in England and Wales (Palmer 1891) which shows a few cases of lay benefactors requesting burial next to particular friars.)

Consistent with the hypothesis that burials of friars were not at Ipswich generally segregated from those of layfolk, there is no evidence for spatial patterning with respect to age and sex within the 6 of the 7 locations in which the burials of females and children are found in addition to those of adult males. The exception to this is in the church choir: there are only 5 burials of infants (those thought to be aged under 2 years at death) in the friary as a whole: all these are located towards the east end of the church choir. Segregation of young children also occurred at the Oxford Blackfriars (Harman 1985) where they were located in the Chapter House.

Of the infant burials 2049 was aged about 31 weeks in-utero and 1314 about 33-34 weeks. The normal gestation period for a human foetus is 40-42 weeks, but after about 28 weeks the foetus is potentially viable, and, given care, might be expected to survive (discussion in Molleson 1989). It was not possible to determine from the skeletal remains whether these infants were stillborn or died during the immediate post-natal period.

Table 12: Percentage of juveniles in Friary assemblages

| Site | % juvenile | Number of burials |
|---|---|---|
| Leicester Austin Friars | 26.9 | 26 |
| Chester Blackfriars | 24.5 | 49 |
| Hartlepool Greyfriars | 21.2 | 118 |
| Oxford Blackfriars* | 21.0 | 83 |
| Oxford Greyfriars* | 20.4 | 49 |
| Guildford Blackfriars* | 11.5 | 113 |
| Chelmsford Blackfriars | 10.1 | 138 |
| Ipswich Blackfriars | 9.6 | 250 |
| Carlisle Blackfriars* | 8.9 | 214 |
| Northampton Greyfriars | 8.3 | 24 |

Note: references as Table 10, juveniles defined as those aged under 18, except * where individuals aged under 20 were classed as juveniles.

In the absence of modern medical care the number of deaths in childhood is generally high - up to 40% of deaths may occur in the under 15 age group, with most of these occurring during infancy (discussion in Brothwell 1987); in addition there is documentary evidence that infant mortality was high during the Mediaeval period, even among the wealthier classes (Thrupp 1962). Thus the relative lack of immature individuals in general, and infants in particular, at Ipswich Blackfriars is very unlikely to reflect a low infant and childhood mortality among the people using the friary for burials. One factor contributing to the low proportion of immature individuals is that an (unknown) proportion of the assemblage are interments of friars. Although entry to the order of the Dominican friars could occur during adolescence or even childhood (Hinnebusch 1951: 317f) the overall effect of the burials of religious will tend to be to bias the assemblage towards adults as well as towards males.

Table 13: Mean age at death of adults in skeletal series and from documentary sources (of Mediaeval date unless stated)

| Site/source | Mean age | No of skeletons |
|---|---|---|
| Carlisle Blackfriars | 32.4 | 90 |
| Oxford Blackfriars | 32.7 | 43 |
| Guildford Blackfriars | 35.2 | 50 |
| Chelmsford Blackfriars | 35.6 | 93 |
| Ipswich Sch. St (10th-11th cent) | 35.7 | 52 |
| St Helen's, York | 38.0 | 474 |
| Ipswich Blackfriars | 40.8 | 186 |
| Hartlepool Greyfriars | 46.4 | 93 |
| Secular Peerage 1350-1500 | 46.1 | - |
| London Merchants 1448-1520 | 49.7 | - |
| From inquests post-mortem 1250-1348 | 50.3 | - |

References for archaeological studies as above. The last 3 entries in Table 13 give figures for life expectancy at age 20 from documentary sources: figures for the secular peerage are from Hollingsworth (1975), those for London merchants are from Thrupp (1962) and those calculated using entries in the inquisitions post-mortem are from Russell (1937). For all three the data are for males only.

Table 14: Percentage of adults aged over about 45 years at death from skeletal series and documentary sources

| Site/source | Percentage of aged adults over 45 |
|---|---|
| St Nicholas Shambles, London | 11.3 |
| Chelmsford Blackfriars | 17.2 |
| Carlisle Blackfriars | 18.9 |
| Oxford Blackfriars | 20.9 |
| St Helen-on-the Walls, York | 23.0 |
| Ipswich Sch. St (10th-11th cent) | 23.1 |
| Guildford Blackfriars | 30.0 |
| Ipswich Blackfriars | 32.3 |
| Hartlepool Greyfriars | 54.9 |
| Data from inquisitions post-mortem 1250-1348 | 60.4 |
| London Merchants 1448-1520 (doc sources) | 60.8 |

Number of individuals for skeletal data and references as above, except St Nicholas Shambles data which refer to 133 adults and are from White (1988). The documentary data refer to males only.

The Ipswich Blackfriars adults seem to be slightly older on average compared with adults from the Mediaeval archaeological sites listed in Tables 13 & 14, the exception to this pattern is at the Hartlepool Greyfriars, where the estimated mean age at death of adults, and the proportion older than about 45 years were quite markedly greater than at the other sites. Compared with the 10th-11th century material from the same site, the 13th-16th century Ipswich Blackfriars adults were in general rather older; this difference in age at death is reflected in differences in the type and frequency of bony pathologies suffered by the 2 groups (Section 5).

Turning to the documentary evidence, it is apparent that, compared with the Ipswich Blackfriars data, and the archaeological evidence in general, it shows a greater mean length of life and a greater proportion of adult deaths at older than 45 years. Documentary evidence relating to members of the secular peerage summoned to parliament (Hollingsworth 1975), the merchant classes (Thrupp 1962) and the upper classes, represented in the inquisitions post-mortem (Russell 1937), give similar values for mean age at death of about 45-50 years, with about 60% of adults dying at ages greater than 45 years. Several factors need to be considered when attempting to interpret the marked discrepancy between the archaeological and documentary evidence. Firstly, all the documentary evidence is biased towards the upper end of the social scale, and refers solely to males. It is difficult to assess the social classes from which burials in friaries are drawn, but Hinnebusch (1951: 287) states that friars themselves were generally drawn from the lesser nobility and the middle classes. Documentary evidence relating to burials of benefactors (e.g. Palmer 1891; Golding 1986) shows that burials at friaries often included members of the nobility, and monastic annalists stress the importance attached by religious communities to the burial of wealthy patrons or benefactors in their own churches: according to Matthew Paris friars hung around the deathbeds of magnates and the wealthy so that they made secret wills commending themselves to the friars alone (Golding 1986). However the overall social composition of those layfolk buried at friaries is hard to resolve (discussion in Poulton & Woods 1984), although given the need for the friars to support themselves, the poorer sections of society are unlikely to be represented (ibid.). Several archaeological reports (e.g. Daniel 1986: 272; Poulton & Woods 1984: 44f) comment that burial within the friary buildings is likely to be more desirable than burial in the cemetery associated with the friary, so perhaps the excavated Ipswich burials represent the wealthier benefactors.

Secondly Thrupp (1962) and Russell (1937) select their data to exclude the great plague years; this factor will tend to increase their age at death figures compared with Mediaeval archaeological data.

Thirdly it may be that anthropological methods tend to under-age adult remains, as has been contended by previous writers (e.g. Cayton 1980) when comparing archaeological with documentary demographic data. The major method used to age the adults in the present collection, dental wear, has been shown to be reliable on a wide range of groups of known age, although in the present work it is unfortunate that insufficient juveniles were present to calibrate the rate of wear in the group under study.

In conclusion it seems probable that all 3 factors discussed above played some part in the discrepancies between the archaeological and the documentary adult age at death data.
It is a frequent finding in archaeological groups that female adults show a lower mean age at death than males, and this is often ascribed to mortality associated with childbirth. Unlike the case at the School Street Anglo-Saxon cemetery the age at death for males and females at the Ipswich Blackfriars is similar (Table 8), although the comparison between the sexes here is

complicated by the probability that the male part of the assemblage represent a mixture of friars and layfolk, while the female burials clearly cannot be friars.

### *3. Metric variation*

The data discussed in this section relates to adults only.

*(a) Stature*

Stature is calculated from long-bone measurements using the formulae of Trotter & Gleser (1952, 1958). The figures in Tables 15-17 are in centimetres unless stated.

Table 15: Distribution of adult stature

| | 144<x<148 | 148<x<152 | 152<x<156 | 156<x<160 | 160<x<164 | 164<x<168 | 168<x<172 | 172<x<176 | 176<x<180 | 180<x<184 | 184<x<188 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | 0 | 0 | 0 | 0 | 4 | 14 | 39 | 47 | 20 | 6 | 1 |
| Females | 1 | 0 | 8 | 18 | 17 | 5 | 6 | 2 | 1 | 0 | 0 |

Table 16: Adult stature means and ranges

| | N | Mean | Range |
|---|---|---|---|
| Males | 131 | 172.7 (5'8") | 162.3-185.1 (5'4"-6'1") |
| Females | 58 | 161.1 (5'3") | 146.3-176.9 (4'10"-5'10") |

Table 17: Stature comparisons

| | Males | | Females | |
|---|---|---|---|---|
| | Mean | N | Mean | N |
| Guildford Blackfriars | 173 | 47 | 161 | 9 |
| Oxford Blackfriars | 173 | 18 | - | - |
| Ipswich Blackfriars | 173 | 131 | 161 | 58 |
| Ipswich Sch. St (10-11th cent) | 172 | 26 | 159 | 23 |
| Ipswich Whitefriars | 172 | 8 | 157 | 3 |
| Chelmsford Blackfriars | 171 | 39 | 157 | 23 |
| Carlisle Blackfriars | 171 | 54 | 160 | 20 |
| Chester Blackfriars | 169 | 16 | 161 | 4 |
| Pooled Mediaeval (Manchester 1983) | 172 | - | - | - |
| Modern (White 1988) | 174 | - | 161 | - |

The stature figures from Ipswich Blackfriars are similar to modern and to other Mediaeval data. They are also of similar stature to the 10th-11th century material excavated from the same site, although the Mediaeval skeletons seem to be of rather more robust build.

*(b) Cranial measurements*

Although many of the skeletons are quite complete and well preserved, the crania in particular are often rather fragmentary; this limited the number of measurements which could be taken. Cranial measurements are selected from Howells (1973).

(i) Raw measurements (in millimetres)

Table 18: Cranial measurements: males

| | N | Mean | s.d. |
|---|---|---|---|
| Glabello-occipital length | 45 | 184.4 | 7.8 |
| Cranial breadth | 38 | 145.8 | 6.8 |
| Basi-bregmatic height | 20 | 134.7 | 4.7 |
| Basion-nasion length | 19 | 103.9 | 3.9 |
| Maximum frontal breadth | 61 | 123.3 | 6.2 |
| Bimaxillary breadth | 16 | 96.8 | 8.2 |
| Bizygomatic breadth | 9 | 133.7 | 5.1 |
| Bifrontal breadth | 64 | 100.1 | 4.4 |
| Bregma-lambda chord | 66 | 112.3 | 6.5 |
| Lambda-opisthion chord | 58 | 97.1 | 5.1 |
| Mastoid height | 96 | 30.5 | 2.9 |
| Nasion-bregma chord | 79 | 111.4 | 4.2 |
| Biasterionic breadth | 53 | 114.0 | 5.6 |
| Simotic chord | 32 | 10.1 | 2.8 |
| Orbital breadth | 17 | 41.2 | 1.8 |
| Orbital height | 17 | 33.8 | 1.7 |
| Foramen magnum length | 22 | 37.7 | 3.5 |

Table 19: Cranial measurements: females

| | N | Mean | s.d. |
|---|---|---|---|
| Glabello-occipital length | 18 | 178.3 | 7.1 |
| Cranial breadth | 16 | 139.7 | 8.2 |
| Basi-bregmatic height | 10 | 128.9 | 4.8 |
| Basion-nasion length | 9 | 96.8 | 3.3 |
| Maximum frontal breadth | 23 | 119.0 | 5.9 |
| Bimaxillary breadth | 10 | 91.6 | 10.4 |
| Bizygomatic breadth | 4 | 124.8 | 7.4 |
| Bifrontal breadth | 27 | 97.2 | 4.4 |
| Bregma-lambda chord | 27 | 109.7 | 5.4 |
| Lambda-opisthion chord | 18 | 95.4 | 5.1 |
| Mastoid height | 43 | 28.4 | 2.6 |
| Nasion-bregma chord | 23 | 109.8 | 3.7 |
| Biasterionic breadth | 18 | 108.8 | 4.3 |
| Simotic chord | 14 | 8.8 | 2.1 |
| Orbital breadth | 10 | 40.1 | 1.7 |
| Orbital height | 10 | 34.1 | 1.3 |
| Foramen magnum length | 8 | 36.9 | 1.5 |

(ii) Indices. These were calculated according to the definitions of Vallois (1965).

Table 20: Cranial indices: summary statistics

| | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | Range | N | Mean | s.d. | Range |
| Cranial index | 32 | 78.6 | 5.1 | 68.6-88.8 | 14 | 78.4 | 6.3 | 62.8-86.9 |
| Height (to basion)-breadth index | 18 | 92.8 | 5.4 | 82.4-104.4 | 8 | 94.0 | 5.4 | 84.6-99.3 |
| Height (to basion)-length index | 19 | 73.1 | 3.1 | 66.5-78.2 | 9 | 73.1 | 3.0 | 69.4-78.0 |
| Orbital index | 17 | 82.0 | 3.8 | 74.0-88.3 | 10 | 85.0 | 5.8 | 75.7-91.6 |

Since the differences in the indices for males and females are statistically insignificant, they are henceforth combined.

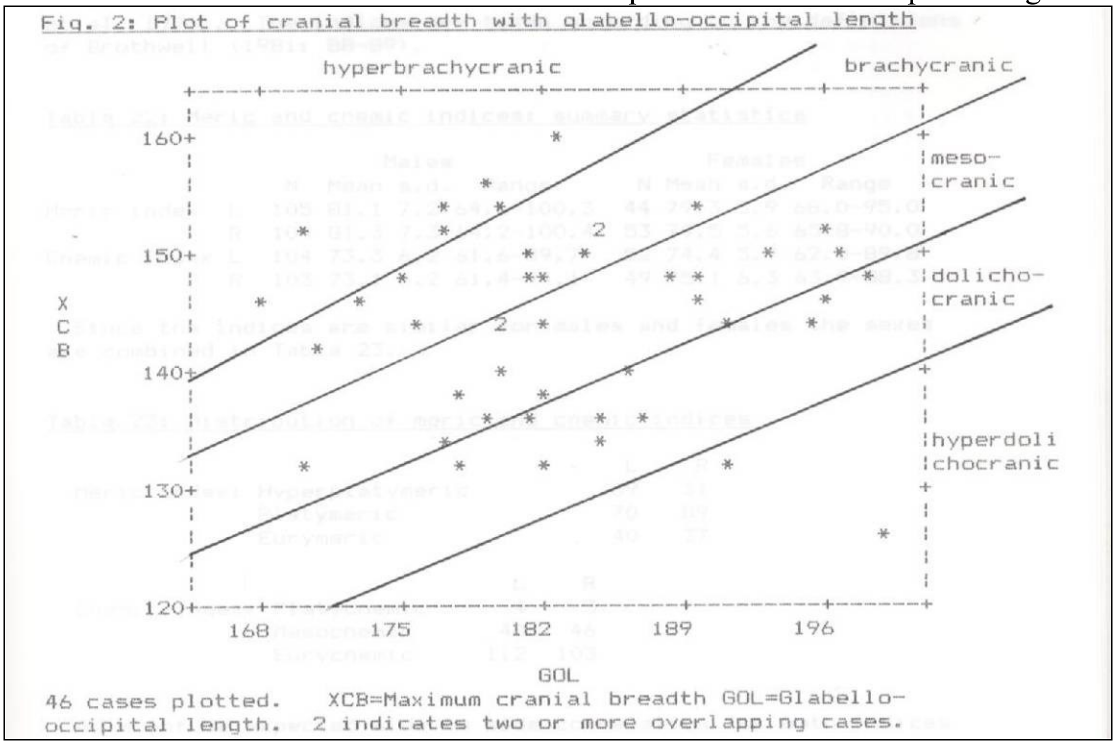
Table 21: distribution of cranial indices

| | | |
|---|---|---|
| Cranial index: | Hyperbrachycranic | 7 |
| | Brachycranic | 13 |
| | Mesocranic | 14 |
| | Dolichocranic | 10 |
| | Hyperdolichocranic | 2 |
| Height-breadth index: | Tapeinocranic | 11 |
| | Metriocranic | 10 |
| | Acrocranic | 5 |
| Height-length index: | Chamaecranic | 6 |
| | Orthocranic | 15 |
| | Hypsicranic | 7 |
| Orbital index: | Chamaeconchic | 2 |
| | Mesoconchic | 15 |
| | Hypsiconchic | 10 |

Due to the nature of the material from the Saxon cemetery at the School Street site very few cranial measurements could be taken, hence no comparisons can be drawn.

The mean cranial index is similar to that noted for Mediaeval crania from Rivenhall, Essex (about 78 - calculated from O'Connor 1984) and that for the skulls from the Chelmsford Blackfriars (about 79 - estimated from Bayley 1975). At the Anglo-Saxon site at Burgh Castle, Norfolk, mean cranial index is 74.2 (calculated from Anderson & Birkett 1989), at Anglo-Saxon Brandon Staunch Meadow, Suffolk, the mean is 73.3 (Anderson 1990), and for the Anglo-Saxon material from Caister-on-Sea, Norfolk, the figure is 75.0 (Anderson 1991); for the Saxon material from Norwich Castle (Stirland 1985), North Elmham Park, Norfolk, (Wells 1980) and Great Chesterford, Cambridgeshire, (Waldron 1988) means are not given but the skulls are predominantly dolichocranic. It has been suggested (Brothwell 1972) than in general dolichocrany prevails in Anglo-Saxon populations and brachycrany in Mediaeval groups; this change in skull shape around the time of the Norman conquest has also been demonstrated in skeletal series from York (Dawes 1980) and the data discussed above suggests that this may also apply to the East Anglia region.

The cranial indices for adults from the Blackfriars are plotted on a bivariate plot in Fig. 2.




46 cases plotted. XCB=Maximum cranial breadth GOL=Glabello-occipital length. 2 indicates two or more overlapping cases.

The outlier with a very hyperdolichocranic index of 62.8 is burial 1874 (female, probably aged about 25-35). It may be that this represents a case of scaphocephaly - premature suture closure. All 3 vault sutures are in a rather advanced state of closure considering the age at death of about 25-35 consistent with the state of the pubic symphyses and the dental wear. The elongated nature of the skull suggests earliest closure of the sagittal suture.

The quantity of missing data was such that no attempt at multivariate analysis of the cranial measurements was made - of the 226 adults, in only 21 could three-quarters or more of the cranial measurements used in the present work be taken.

*(c) Post-cranial measurements*

(i) Meric and cnemic indices. The meric index is a measure of the anterio-posterior flattening of the femur in the sub-trochanteric region; the cnemic index expresses the transverse flattening of the tibia at the level of the nutrient foramen.

The precise significance of these indices is disputed, but it seems probable that this type of variation in shaft cross-section reflects patterns of mechanical stress on the bone (e.g. Lovejoy et al. 1976). The indices are taken according to the definitions of Brothwell (1981: 88-89).

Table 22: Meric and cnemic indices: summary statistics

| | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | Range | N | Mean | s.d. | Range |
| Meric index L | 105 | 81.1 | 7.2 | 64.6-100.3 | 44 | 79.3 | 5.9 | 68.0-95.0 |
| R | 104 | 81.3 | 7.3 | 64.2-100.4 | 53 | 79.5 | 5.6 | 65.8-90.0 |
| Cnemic index L | 104 | 73.3 | 6.2 | 61.6-89.7 | 52 | 74.4 | 5.9 | 62.0-89.8 |
| R | 103 | 73.1 | 6.2 | 61.4-94.1 | 49 | 75.1 | 6.3 | 63.9-88.3 |

Since the indices are similar for males and females the sexes are combined in Table 23.

Table 23: Distribution of meric and cnemic indices

| | L | R |
|---|---|---|
| Meric index: Hyperplatymeric | 39 | 31 |
| Platymeric | 70 | 89 |
| Eurymeric | 40 | 37 |
| | L | R |
| Cnemic index: Platycnemic | 4 | 3 |
| Mesocnemic | 40 | 46 |
| Eurycnemic | 112 | 103 |

As might be expected side to side correlation for both indices is high (Pearson coefficients in the region of 0.8). For the males, associations between meric and cnemic indices in a particular limb or particular individual are low, none reaching statistical significance (at the 5% level); for the females the correlations are rather higher (about 0.2-0.3 compared with about 0.1 or less for the males), those between the left meric and left cnemic index, and the left cnemic and right meric index reaching statistical significance at the 5% level.

Compared with the 10th-11th century material from the School Street site, the meric and cnemic indices for the 13th-16th century Blackfriars material are both somewhat greater, indicating less flattened femoral and tibial cross sections.

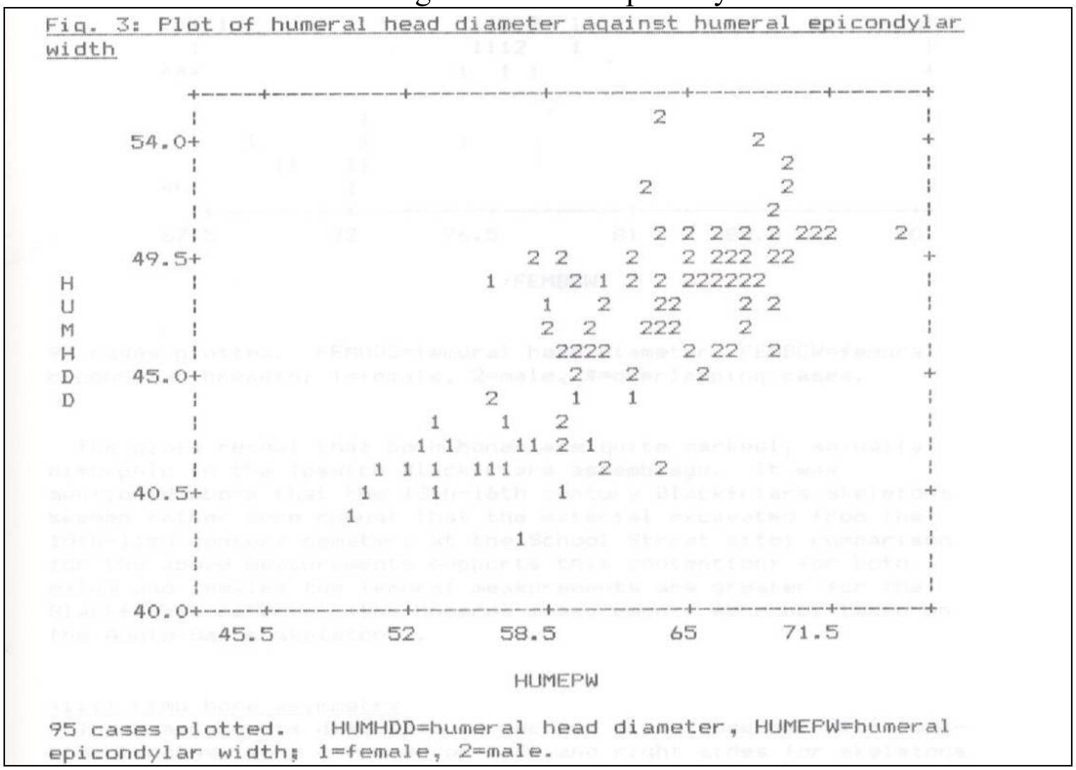
(ii) Robusticity of the femora and humeri

Vertical diameter of the femoral head, femoral bicondylar breadth, humeral head diameter and humeral epicondylar width were taken. These measurements are of some significance in sex determination (discussion in Buikstra & Mielke 1985) and one of the purposes for which they were recorded was to investigate sexual dimorphism in these bones.

| Table 24: Humeral head diameter and epicondylar width and femoral head diameter and bicondylar breadth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Males | | | | Females | | | | |
| | N | Mean | s.d. | Range | N | Mean | s.d. | Range | |
| Humeral head diameter L | 63 | 48.1 | 2.7 | 41.5-54. 9 | 29 | 41.9 | 2.2 | 37.2-47.8 | |
| R | 60 | 48.5 | 2.6 | 43.3-54.2 | 23 | 43.2 | 2.6 | 39.0-48.7 | |
| Humeral epicondylar width L | 85 | 64.7 | 3.7 | 55.8-74.8 | 30 | 56.9 | 3.8 | 49.7-64.6 | |
| R | 64 | 65.7 | 4.9 | 43.6-72.3 | 30 | 57.6 | 4.1 | 50.1-66.1 | |
| Femoral head diameter L | 74 | 49.2 | 2.6 | 42.0-55.5 | 35 | 44.0 | 2.3 | 40.3-48.5 | |
| R | 72 | 49.8 | 2.8 | 44.3-57.6 | 41 | 44.1 | 2.2 | 40.2-48.1 | |
| Femoral bicondylar breadth L | 69 | 82.7 | 3.5 | 76.5-90.0 | 29 | 75.4 | 4.3 | 67.7-86.8 | |
| R | 62 | 83.3 | 3.5 | 76.9-90.1 | 20 | 76.7 | 3.9 | 49.0-87.4 | |

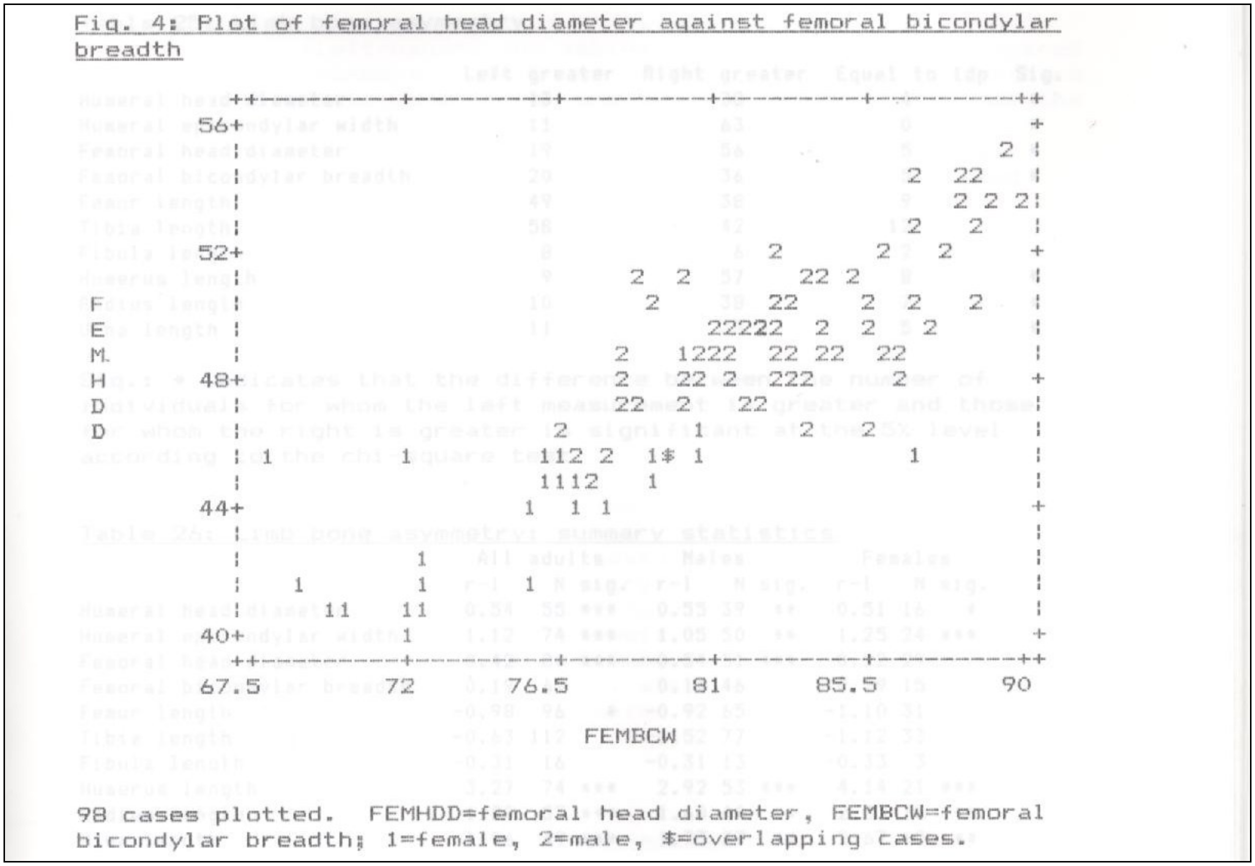
Plots of these figures are shown in Figs. 3 and 4.

Fig. 3: Plot of humeral head diameter against humeral epicondylar width




95 cases plotted. HUMHDD=humeral head diameter, HUMEPW=humeral epicondylar width; 1=female, 2=male.

Fig. 4: Plot of femoral head diameter against femoral bicondylar breadth




98 cases plotted.  FEMHDD=femoral head diameter, FEMBCW=femoral bicondylar breadth; 1=female, 2=male, $=overlapping cases.

The plots reveal that both bones are quite markedly sexually dimorphic in the Ipswich Blackfriars assemblage.  It was mentioned above that the 13th-16th century Blackfriars skeletons seemed rather more robust that the material excavated from the 10th-11th century cemetery at the School Strret site; comparison for the above measurements supports this contention: for both males and females the femoral measurements are greater for the Blackfriars material (the humerus measurements were not taken on the Anglo-Saxon skeletons).

(iii) Limb bone asymmetry

The measurements discussed in section (ii), together with long-bone lengths, were compared on left and right sides for skeletons where both sides were intact for measurement, in order to study any directional asymmetry in the appendicular skeleton.

Table 25: Limb bone asymmetry

| | Left greater | Right greater | Equal to 1dp | Sig. |
|---|---|---|---|---|
| Humeral head diameter | 13 | 38 | 4 | * |
| Humeral epicondylar width | 11 | 63 | 0 | * |
| Femoral head diameter | 19 | 56 | 5 | * |
| Femoral bicondylar breadth | 20 | 36 | 5 | * |
| Femur length | 49 | 38 | 9 | |
| Tibia length | 58 | 42 | 12 | |
| Fibula length | 8 | 6 | 2 | |
| Humerus length | 9 | 57 | 8 | * |
| Radius length | 10 | 38 | 7 | * |
| Ulna length | 11 | 33 | 5 | * |

Sig.: * indicates that the difference between the number of individuals for whom the left measurement is greater and those for whom the right is greater is significant at the 5% level according to the chi-square test.

Table 26: Limb bone asymmetry: summary statistics

| | All adults | | | Males | | | Females | | |
|---|---|---|---|---|---|---|---|---|---|
| | r-l | N | sig. | r-l | N | sig. | r-l | N | sig. |
| Humeral head diameter | 0.54 | 55 | *** | 0.55 | 39 | ** | 0.51 | 16 | * |
| Humeral epicondylar width | 1.12 | 74 | *** | 1.05 | 50 | ** | 1.25 | 24 | *** |
| Femoral head diameter | 0.42 | 80 | *** | 0.54 | 51 | *** | 0.22 | 29 | |
| Femoral bicondylar breadth | 0.19 | 61 | | 0.16 | 46 | | 0.29 | 15 | |
| Femur length | -0.98 | 96 | * | -0.92 | 65 | | -1.10 | 31 | |
| Tibia length | -0.63 | 112 | | -0.52 | 77 | | -1.12 | 33 | |
| Fibula length | -0.31 | 16 | | -0.31 | 13 | | -0.33 | 3 | |
| Humerus length | 3.27 | 74 | *** | 2.92 | 53 | *** | 4.14 | 21 | *** |
| Radius length | 1.80 | 55 | *** | 1.60 | 40 | ** | 2.33 | 15 | *** |
| Ulna length | 1.96 | 49 | *** | 1.73 | 37 | ** | 2.67 | 12 | ** |

r-l=mean for right bones-mean for left bones (i.e. a negative figure in this column indicates that the mean for left bones was the greater) sig.=significance level of the difference between left and right side means according to the paired t-test, ***=significant at the 0.1% level, **=significant at the 1% level, *=significant at the 5% level and blank denotes a non-significant difference.

Several studies have demonstrated a greater length of forearm (refs in Falk et al. 1988), and upper and forearm bones (Schulter-Ellis 1980), on the dominant side, and there is some evidence that the strength of such associations is increased by unilateral activity involving the dominant arm. A problem with these and other studies which have investigated directional asymmetry associated with handedness is the relatively low numbers of left-handed individuals - it seems unclear whether the asymmetries observed are directional for the dominant arm or are directional to the right side, regardless of handedness. For example Schell et al. (1985) found a greater humeral epicondylar width (taken on living subjects) on the right in right-handed individuals but no significant difference between left and right sides in non right-handers, but the study included only 19 non right-handers (left-handed and ambidextrous individuals) compared with 116 right handers. van Dusen (1939) found greater right arm and hand dimensions in children and Schultz (1926) found that the right humerus was longer than the left in a statistically significant number of cases in foetal material. Directional asymmetry in leg and foot bones generally seems to be lacking (e.g. Schell et al. 1985; Schultz 1926; refs in Falk et al. 1988).

The Ipswich Blackfriars data show significant directional asymmetry favouring the right side in all the arm bone measurements whereas for the leg bones (with the exception of femoral head diameter) no directional asymmetry was found. This pattern is broadly compatible with that found by the writers cited above and would seem to be a reflection of handedness (assuming a majority of right handers, as is the norm in human populations).

An unexpected result is the directional asymmetry in femoral head diameter. It is difficult to dismiss this highly statistically significant result (both in terms of the paired ttest and the chi-square test, above). None of the workers cited above studied laterality in this measurement. Since it is most unlikely that it represents asymmetry through increased use of the right limb over the left (particularly as no other leg bones measurements show directional asymmetry), it may be a manifestation of inborn lateralisation of the type described for foetal arm bones by Schultz (1926), although why this should be the case for the femoral head diameter and no other leg bone measurements is a mystery.

### *4. Non-metric variation*

Non-metric traits take the form of minor variations in skeletal morphology such as presence or absence of bony spurs or foramina. For at least some of these variants there is evidence that they are to some extent inherited, although the causation of many remains obscure. Thirty-three cranial and 20 post-cranial traits are scored. The cranial traits are mainly selected from those defined by Berry & Berry (1967). Those not studied by Berry & Berry (1967) are selected from de Villiers (1968) and Ossenburg (1977). Where the scoring rules of Berry & Berry (1967) conflict with those of Sjo/vold (1984) the latter are used. The post-cranial traits are those defined by Finnegan (1978).

In children the presence of many traits is age correlated; most workers omit these individuals from population studies, a strategy pursued for the variants scored in Tables 27 and 28.

Table 27: Frequencies of cranial non-metric traits

| Trait | 1 | 0 | 1/1 | -/1 | 1/- | 1/0 | 0/1 | -/0 | 0/- | 0/0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Metopic suture | 17 | 155 | | | | | | | | |
| Ossicle at lambda | 18 | 115 | | | | | | | | |
| Lambdoid ossicle | 76 | 48 | | | | | | | | |
| Inca bone | 1* | 147 | | | | | | | | |
| Sagittal ossicle | 2 | 67 | | | | | | | | |
| Ossicle at bregma | 0 | 152 | | | | | | | | |
| Coronal ossicle | 7 | 118 | | | | | | | | |
| Fronto-temporal articulation | | | 1 | 0 | 0 | 1 | 0 | 23 | 22 | 60 |
| Squamo-parietal ossicle | | | 0 | 1 | 0 | 1 | 1 | 22 | 26 | 87 |
| Epipteric bone | | | 1 | 0 | 2 | 2 | 0 | 23 | 23 | 53 |
| Parietal notch bone | | | 2 | 1 | 1 | 2 | 10 | 19 | 27 | 102 |
| Auditory torus | | | 0 | 0 | 0 | 0 | 0 | 13 | 17 | 126 |
| Foramen of Hushke | | | 4 | 1 | 1 | 6 | 0 | 11 | 19 | 111 |
| Ossicle at asterion | | | 6 | 3 | 1 | 7 | 5 | 16 | 21 | 92 |
| Clinoid bridging | | | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Palatine torus | 21 | 105 | | | | | | | | |
| Maxillary torus | 8 | 92 | | | | | | | | |
| Mastoid foramen extra-sutural | | | 43 | 4 | 3 | 26 | 23 | 9 | 8 | 48 |
| Mastoid foramen absent | | | 4 | 1 | 0 | 8 | 8 | 12 | 11 | 123 |
| Double condylar facet on occipital | | | 1 | 1 | 0 | 2 | 0 | 15 | 17 | 58 |
| Parietal foramen | | | 46 | 3 | 0 | 17 | 23 | 2 | 4 | 62 |
| Accessory infra-orbital foramen | | | 3 | 3 | 3 | 2 | 2 | 20 | 15 | 39 |
| Zygomatic-facial foramen | | | 88 | 18 | 20 | 11 | 7 | 3 | 3 | 9 |
| Divided hypoglossal canal | | | 6* | 4* | 6+ | 11* | 7+ | 17 | 12 | 51 |
| Posterior condylar canal patent | | | 29 | 13 | 14 | 6 | 5 | 10 | 7 | 11 |
| Precondylar tubercle | | | 3 | 0 | 0 | 5 | 0 | 9 | 7 | 71 |
| Foramen ovale incomplete | | | 1 | 0 | 1 | 1 | 0 | 21 | 24 | 33 |
| Accessory lesser palatine foramen | | | 23 | 9 | 13 | 7 | 2 | 5 | 5 | 4 |
| Supra-orbital foramen complete | | | 18~ | 6 | 2 | 21# | 11# | 6 | 10 | 88 |
| Maxillary M3 agenesis | | | 16 | 2 | 2 | 5 | 3 | 14 | 11 | 60 |
| Mandibular M3 agenesis | | | 20 | 2 | 2 | 3 | 4 | 12 | 11 | 79 |
| Mandibular torus | 2 | 109 | | | | | | | | |
| Mylohyoid bridging | | | 5* | 7* | 5 | 9 | 5* | 15 | 12 | 64 |

1=trait present 0=trait absent -=no observation possible. Scores for bilateral traits are presented as score for left side/score for right side. *=includes 1 partial manifestation of trait, +=includes 2 cases of partial manifestations of the trait, #=includes 3 cases of partial manifestations of the trait ~=includes 5 cases of partial manifestations of the trait.

Table 28: Frequencies of postcranial non-metric traits

| Trait | 1 | 0 | 1/1 | -/1 | 1/- | 1/0 | 0/1 | -/0 | 0/- | 0/0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Fossa of Allen | | | 13 | 2 | 1 | 2 | 10 | 29 | 19 | 84 |
| Plaque formation | | | 31 | 12 | 7 | 5 | 11 | 11 | 14 | 63 |
| Exostosis in trochanteric fossa | | | 70 | 18 | 17 | 10 | 5 | 8 | 5 | 34 |
| Supra-condyloid process | | | 0 | 0 | 0 | 0 | 0 | 15 | 20 | 144 |
| Septal aperture | | | 1 | 0 | 1 | 3 | 0 | 19 | 21 | 138 |
| Acetabular crease | | | 10 | 1 | 1 | 3 | 5 | 15 | 20 | 114 |
| Accessory sacral facets on ilium | | | 0 | 3 | 1 | 2 | 3 | 11 | 17 | 55 |
| Spina bifida occulta | $6^{+}$ | 118 | | | | | | | | |
| Sixth sacral segment | $17^{+}$ | 61 | | | | | | | | |
| Acromial articular facet | | | 3 | 2 | 1 | 1 | 2 | 16 | 27 | 72 |
| Os acromiale | | | 2 | 0 | 2 | 2 | 6 | 18 | 26 | 68 |
| Supra-scapular foramen | | | 0 | 3 | $1^{*}$ | $3^{+}$ | 2 | 19 | 20 | 91 |
| Vastus notch | | | 22 | 6 | 8 | 13 | 11 | 14 | 14 | 42 |
| Vastus fossa | | | 8 | 5 | 7 | 7 | 4 | 14 | 17 | 70 |
| Emarginate patella | | | 0 | 0 | 0 | 0 | 0 | 19 | 23 | 90 |
| Anterior calcaneal facet double | | | 61 | 3 | 3 | 14 | 8 | 8 | 3 | 87 |
| Anterior calcaneal facet absent | | | 9 | 0 | 1 | 1 | 2 | 10 | 5 | 159 |
| Atlas facet double | | | 6 | 4 | 5 | 7 | 8 | 12 | 6 | 65 |
| Posterior atlas bridging | | | 1 | $1^{*}$ | 1 | $5^{+}$ | $1^{*}$ | 17 | 33 | 77 |
| Lateral atlas bridging | | | 0 | 1 | 0 | 1 | 1 | 15 | 14 | 71 |

1=trait present 0=trait absent -=no observation possible. Scores for bilateral traits are presented as score for left side/score for right side. *=includes 1 partial manifestation of trait, +=includes 2 cases of partial manifestations of the trait,

Of these 53 traits a chi-square test shows that 6 traits (anterior calcaneal facet double, palatine torus, extra-sutural mastoid foramen, maxillary and mandibular M3 absent and fossa of Allen) have significantly different frequencies (at the 5% level) between males and females. This number is greater than that which might be expected by chance alone. Studies of the frequencies of non-metric variants often report some few traits for which the difference in frequency between the sexes reaches significance, but, as Berry (1975: 528) remarks "there seems little consistency in the occurrence of these dimorphisms, and a variant predominating in males in one sample may predominate in females in another". It thus seems unlikely that differences in frequencies between the sexes reflect any biological predisposition for either presence of absence of particular traits. The explanation for the differences in frequency between the sexes for the 6 traits in the present material is obscure, but perhaps it reflects a difference in genetic composition of the male and female parts of the assemblage, the latter being drawn from the population of layfolk whereas the former are a mixture of layfolk and friars.

The occurrences of those traits for which a literature search (Mays 1987) revealed evidence for a genetic component in their causation were plotted on the site plan in an attempt to discern whether there was any spatial patterning which might be interpreted as evidence for genetically related individuals being buried near one another in "family groups". This exercise revealed no such evidence. The data were also subjected to a multivariate analysis by which a similarity coefficient between each pair of individuals was generated, taking into account the traits which they shared in common; the results were then used as the input for a cluster analysis, the reasoning being that the clusters thus produced might be expected to correspond to groups of related individuals. These clusters were plotted onto the site plan. Consistent with the results above, this exercise produced no evidence for the existence of "family groups" among the friary burials.

Thus there is no evidence from either univariate or multivariate analysis of the non-metric variants that genetic relationships with pre-existing interments was an important factor in determining location of burials. Palmer (1891) collected together evidence from wills of some of the benefactors buried at 28 friaries. Of 255 individuals recorded as having expressed some preference concerning their place of burial within a particular friary, only 8% stated that they wished to be buried next to blood relatives. The lack of skeletal evidence for the existence of family groups at the Ipswich Blackfriars might be viewed as consistent with this.

There are several features, in addition to those recorded above, which might be viewed as aspects of non-metric variation.

*(a) Hypodontia and localised microdontia*

Hypodontia (congenitally missing tooth or teeth) and localised microdontia (reduction in size of 1 or some few teeth) are thought to be linked and share a significant genetic component in their causation (Graber 1978; Grahnen 1956; Brook 1984). Other than hypodontia of the 3rd molars (which was included in the analysis, above) instances of hypodontia and/or microdontia are detailed below.

Table 29: Hypodontia (other than 3rd molar) and localised microdontia)

| Burial | Hypodontia | Microdontia | Notes |
|---|---|---|---|
| 0669 (juvenile aged about 14) | Both maxillary PM2s & right mandibular PM2 | - | Where the PM2s are missing the deciduous M2s are retained. Both maxillary, and the left mandibular M3 absent. |
| 0953 (male aged 25-35) | - | Maxillary M2s | - |
| 1459 (male aged 25-35) | Right maxillary I2 | Left maxillary I2 | - |
| 1757 (male aged 40-50) | Right mandibular I2 | - | - |
| 1797 (female aged 30-40) | - | Mandibular M3s | - |
| 1846 (female aged 25-35) | - | Left mandibular M3 | - |
| 1999 (male aged 21-24) | All 4 PM2s & right maxillary I2 | - | All 4 M3s absent. Deciduous M2s retained. |
| 2457 (female aged 30-40) | - | Maxillary M3s | - |
| 2482 (male aged 35-45) | Left maxillary I2 | - | - |
| 2533 (female aged 35-45) | Both mandibular, & right maxillary M2 | All teeth rather small, esp. molars | All 4 M3s absent; the maxillary M1s have only 1 root. |
| 2576 (male aged 30-40) | Left maxillary I2 | Right maxillary I2 | - |
| 2617 (male aged 30-40) | Left maxillary canine | - | - |
| 3091 (male? aged 30+) | - | Left maxillary I2 | - |

Other than the 3rd molar, the teeth generally found to be the most frequently absent are the premolars and the maxillary lateral incisors (Grahnen 1956; Graber 1978). The present results are consistent with this, but the missing second molars of burial 2533 are unusual.

(b) Vertebral fusion

Fusion of 2 vertebrae was classified as congenital where no evidence of trauma or disease was present. In general no osteophytes were present at the line of fusion, which is usually visible, albeit sometimes faintly.

Table 30: Probable cases of congenital block vertebrae

| Burial | Fused vertebrae | Location of fusion |
|---|---|---|
| 0740 (male aged 30-40) | C3 & 4 | Bodies, facet joints & neural arches |
| | C5 & 6 | Bodies, facet joints, right side of neural arches |
| | T3 & 4 | Bodies, facet joints and neural arches |
| 1012 (male aged 40-50) | C3 & 4 | Facet joints |
| 1376 (female aged 30-40) | C6 & 7 | Bodies |
| 1418 (male aged 40-50) | 2 middle thoracics | Bodies (other parts missing) |
| 1455 (male aged about 18) | 2 middle thoracics | Left facet joints |
| 1795 (female aged 45-60) | C2 & 3 | Right facet joint & right Luschka joint; left parts of bone missing |
| 1952 (female aged 25-35) | T5 & 6 | Anterior/left side of bodies |
| 2386 (female aged 35-45) | C2 & 3 | Left facet joint, left side of neural arch |
| 2448B (male aged 25-45) | C2 & 3 | Left side of bodies & neural arches; left facet joint |
| 3054 (female aged 40-50) | C2 & 3 | Left facet joint |

In burial 0740 there are several other vertebral anomalies in addition to the block vertebrae. There is some scoliosis at the fused C5 & 6, and the neural arches of these vertebrae show failure of fusion at the midline - spina bifida occulta. There is a supernumary articulation between the neural spine of T6 and the neural arch of T7. There are 6 lumbar vertebrae, the last of which shows spina bifida occulta.

In most of the cases of block vertebrae there was marked osteophytosis and/or osteoarthritis on the intervertebral joints adjacent to the fused vertebrae, reflecting the increased strain put upon these joints as a consequence of the immobility of their neighbours.

*(c) Spondylolysis*

Spondylolysis is the condition where the posterior part of the neural arch is cleft from the rest of the vertebra at the pars interarticularis; thus in skeletal material the posterior part of the neural arch appears as a separate fragment, although in life it is bound to the rest of the vertebra by fibrous tissue. The fibrous union between the 2 parts of the vertebra may be ruptured by trauma, leading to forward slippage of the vertebral body - spondylolisthesis. In skeletal material this is manifested by periosteal reactive bone on the anterior wall of the slipped vertebral body and/or its immediate neighbours, as a result of activation of the periosteum (Ortner & Putschar 1985: 358). It seems that there is a strong inherited component to spondylolysis (e.g. Wynne-Davis & Scott 1979).

Table 31: Spondylolysis

| Burial | Location of defect | Spondylolisthesis |
|---|---|---|
| 0974 (male aged 22-25) | L5 | No |
| 0984 (male aged 50+) | L5 | No |
| 1933 (male adult) | L5 | No |
| 1962 (male aged 22-50) | L5 | No |
| 2332 (male aged 40+) | L4 or 5 | - |
| 2348 (female adult) | L5 | No |
| 2432 (male aged 35-45) | ?L5 | - |
| 2474 (male aged 50+) | L4 & 5 | No |
| 2506 (female aged 30-40) | L4 | Yes |
| 2508 (male aged 35-45) | L5 | No |
| 2622 (male aged 50+) | L5 | Yes |
| 2628 (female aged 50+) | L4 | Yes |
| 2642 (males aged 40-50) | L5 | No |
| 3107 (male aged 50+) | L5 | No |

Studies in modern populations have noted an increased frequency of spina bifida occulta at the lower lumbar or sacral level (Wynne-Davis & Scott 1979; Wiltse 1962) and an increased frequency of lumbo-sacral transitional variations (Wynne-Davis & Scott 1979) in individuals showing spondylolysis. These findings are not born out in the Ipswich Blackfriars assemblage:

only 1 out of the 14 cases of spondylolysis showed spina bifida (burial 0984) or a lumbo-sacral transitional variant (burial 1933 has 6 sacral vertebrae, the 6th being an extra segment, rather than sacralisation of L5). The predominant location of defects at the 5th lumbar vertebra is consistent with findings in modern studies (e.g. Eisenstein 1978).

(d) Other
Two individuals (burials 2624 & 3126) show an unusual scapula variant. There seems to be some dysplasia of the scapula necks which results in the glenoid cavities facing posteriorly (Plate 1). The acromia of 2624 are abnormally high and broad; those of 3126 are missing post-mortem so no observations can be made. In addition the acetabula of 2624 are rather shallow; those of 3126 are missing post-mortem. It seems likely that these represent congenital anomalies. There is evidence from familial studies that dysplasia of the scapula neck, which may (as in the case of burial 2624) be accompanied by anomalies of the acromia and other bony elements of the shoulder joint, has an inherited component in its causation (discussion in Pettersson 1980); it may thus be that burials 2624 and 3126 are closely related genetically, although, consistent with the evidence above that individuals were not generally interred in "family groups" at the Ipwsich Blackfriars, these 2 burials are not near to one another in the friary.

Many individuals show minor skeletal variants, details are given in the Appendix; these include 6 instances of carpal or tarsal coalitions or accessoria (burials 1762, 1980, 2313, 2361, 2626 & 3095) and 2 instances of lumbar ribs (burials 1472 & 1757).

## 5. Pathology

Fuller descriptions of pathological lesions than those given in this section may be found under the entries for individual burials in the Appendix.

### *(a) Oral*
(i) Dental caries. Dental caries was scored as present or absent in each tooth, and as present or absent in individuals with 1 or more erupted teeth available for study. Of the 24 juveniles, 18 had one or more erupted teeth, and of these 7 showed dental caries. The rates in terms of total teeth are 13/194 with respect to permanent teeth and 7/123 with respect to deciduous teeth.

Table 32: Prevalence of dental caries in the adult permanent dentition

| | Individuals Present | Individuals Absent | Carious teeth | Total teeth |
|---|---|---|---|---|
| Males | 76 | 39 | 202 | 2039 |
| Females | 40 | 11 | 99 | 854 |
| Total adults | 117 | 52 | 302 | 2917 |

Table 33: Distribution of dental caries in adult permanent teeth

| | MAXILLA LEFT | | | | | | | | RIGHT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M3 | M2 | M1 | PM2 | PM1 | C | I2 | I1 | I1 | I2 | C | PM1 | PM2 | M1 | M2 | M3 | Un i.d. |
| Teeth | 51 | 89 | 86 | 94 | 95 | 108 | 87 | 68 | 64 | 75 | 106 | 104 | 97 | 94 | 93 | 58 | 2 |
| Carious | 8 | 17 | 15 | 12 | 9 | 5 | 4 | 2 | 2 | 2 | 9 | 13 | 13 | 20 | 21 | 7 | 1 |
| Teeth | 64 | 92 | 86 | 109 | 124 | 114 | 105 | 81 | 89 | 102 | 119 | 113 | 105 | 90 | 96 | 56 | 1 |
| Carious | 14 | 16 | 16 | 7 | 5 | 3 | 2 | 1 | 0 | 3 | 5 | 7 | 12 | 17 | 21 | 13 | 0 |
| | MANDIBLE | | | | | | | | | | | | | | | | |

Although it must be considered a multifactorial disease, many studies of non-industrialised societies (e.g. Turner 1979 & refs therein) have shown a strong correlation between caries rates and carbohydrate consumption. Of the carbohydrates sugars are the most cariogenic. Small amounts of sucrose were imported during the Mediaeval period, but previous studies (Moore & Corbett 1978, 1983) suggest that they had a negligible influence on caries experience. The only widely available sweetening agent was honey. The principal carbohydrates consumed were starches, which are less cariogenic than sugars, but when oral hygiene is poor food residues may be retained in the mouth for sufficient time for starches to be broken down enzymatically to highly cariogenic lower molecular weight carbohydrates (Moore & Corbett 1978; Mörmann & Mühlemann 1981).

When making comparisons between caries prevalence in different groups age at death needs to be taken into account since teeth in older individuals have been longer exposed to the agents of decay.

No significant difference was found between the sexes in terms of caries prevalence with respect to its presence/absence in individuals (standard statistical tests are not valid for prevalences with respect to total teeth). No significant difference was found between caries rates in the 13th-16th century Blackfriars assemblage and the 10th-11th century material from the School Street site. This would appear consistent with the contention of Moore & Corbett (1978) that sugar consumption by most British Mediaeval populations was minor.

From pooled Mediaeval cemetery data Brothwell (1959) found a caries prevalence of 12-15% with respect to total teeth, so the rate with respect to total teeth in the Blackfriars material of 10.4% cannot be considered atypical for a Mediaeval group. The pattern by which molars and premolars are more affected by caries than the anterior dentition is paralleled by modern (Shafer et al. 1983: 436) and archaeological (Moore & Corbett 1983) studies.

(ii) Ante-mortem tooth loss. Ante-mortem tooth loss was scored on a presence-absence basis for each erupted tooth position and as present or absent in individuals with one or more erupted tooth positions available for study. One juvenile showed ante-mortem loss of one permanent tooth (a mandibular M1); the data for adults is shown below.

Table 34: Prevalence of ante-mortem tooth loss in adults

| | Individuals | | | |
|---|---|---|---|---|
| | Present | Absent | No of tooth posits. showing a-m loss | Total tooth positions |
| Males | 80 | 25 | 490 | 2920 |
| Females | 35 | 14 | 238 | 1255 |
| Total adults | 116 | 50 | 731 | 4205 |

Table 35: Distribution of ante-mortem tooth loss in the adult dentition

| | MAXILLA | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LEFT | | | | | | | | RIGHT | | | | | | | |
| | M3 | M2 | M1 | PM2 | PM1 | C | I2 | I1 | I1 | I2 | C | PM1 | PM2 | M1 | M2 | M3 |
| Tooth posits. | 74 | 120 | 133 | 132 | 135 | 140 | 138 | 140 | 132 | 131 | 136 | 131 | 133 | 133 | 124 | 77 |
| A-m loss | 16 | 30 | 43 | 28 | 22 | 15 | 15 | 15 | 16 | 15 | 14 | 23 | 28 | 39 | 31 | 19 |
| Tooth posits. | 101 | 140 | 45 | 142 | 143 | 145 | 142 | 138 | 139 | 144 | 146 | 142 | 143 | 145 | 140 | 101 |
| A-m loss | 31 | 48 | 57 | 21 | 8 | 1 | 2 | 12 | 9 | 4 | 3 | 9 | 26 | 52 | 42 | 37 |
| | MANDIBLE | | | | | | | | | | | | | | | |

Dental caries and diseases of the periodontal tissues are major causes of ante-mortem tooth loss.

As for dental caries, age at death should be taken into account when comparing rates of tooth loss in different groups - if anything ante-mortem tooth loss tends to be more strongly age correlated than dental caries.

Prevalence for males and females at the Blackfriars are similar. The overall rates for adults (69.9% with respect to individuals and 17.4% of total tooth positions) are rather higher than the corresponding figures for the 10th-11th century School Street material (52.3% and 10.5% respectively); the rather older age at death of the Blackfriars adults would seem to be playing a part here.

The pattern by which molars are the most, and the canines the least frequently lost ante-mortem is paralleled by studies on archaeological material (Whittaker et al. 1981) and on living groups which do not have access to modern Western dental surgery (Tal & Tau 1984).

(iii) Alveolar abscesses. These were recorded in terms of affected tooth positions and affected individuals in an analogous fashion to the tooth loss data. Two juveniles showed one alveolar abscess cavity each; the data for adults is shown below.

Table 36: Prevalence of alveolar abscesses in adults

| | Individuals | | | |
|---|---|---|---|---|
| | Present | Absent | No of tooth posits. showing abscesses | No of tooth posits. not showing abscesses |
| Males | 62 | 52 | 164 | 2920 |
| Females | 26 | 23 | 67 | 1255 |
| Total adults | 88 | 77 | 231 | 4205 |

Table 37: Distribution of alveolar abscesses in the adult dentition

| | MAXILLA | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LEFT | | | | | | | | RIGHT | | | | | | | |
| | M3 | M2 | M1 | PM2 | PM1 | C | I2 | I1 | I1 | I2 | C | PM1 | PM2 | M1 | M2 | M3 |
| Tooth posits. | 74 | 120 | 133 | 132 | 135 | 140 | 138 | 140 | 132 | 131 | 136 | 131 | 133 | 133 | 124 | 77 |
| Alv. abscesses | 3 | 9 | 14 | 9 | 8 | 11 | 6 | 4 | 7 | 9 | 5 | 9 | 7 | 17 | 5 | 1 |
| Tooth posits. | 101 | 140 | 145 | 142 | 143 | 145 | 142 | 138 | 139 | 144 | 146 | 142 | 143 | 145 | 140 | 101 |
| Alv. abscesses | 3 | 11 | 9 | 9 | 6 | 6 | 2 | 3 | 4 | 3 | 8 | 8 | 3 | 19 | 11 | 2 |
| | MANDIBLE | | | | | | | | | | | | | | | |

Periapical abscesses are usually a consequence of infection of the pulp cavity of a tooth, which generally occurs if the pulp is exposed to the oral environment as a result of dental caries, excessive attrition or trauma.

As for the ante-mortem tooth loss data the prevalences of alveolar abscesses in the 13th-16th century Blackfriars assemblage (54.4% of individuals, 5.5% with respect to total tooth position) are rather greater than those in the 10th-11th century School Street material (31.0% and 3.3% for individuals and tooth positions, respectively), but again the greater age at death of the Blackfriars individuals may to some extent explain the difference.

(iv) Dental calculus. This is a concretion on the teeth consisting mainly of calcium salts and, in life, organic material in which flourish numerous bacteria. It may be considered as mineralised dental plaque and is associated with poor oral hygiene. It was scored on the scale of Dobney & Brothwell (1987).

| Table 38: Dental calculus | | | | | |
|---|---|---|---|---|---|
| | Degree of development | | | | |
| | 0 | I | II | III | IV |
| Male adults | 20 | 42 | 34 | 10 | 0 |
| Female adults | 13 | 17 | 7 | 7 | 2 |
| All adults | 33 | 60 | 41 | 17 | 2 |
| Juveniles | 11 | 6 | 1 | 0 | 0 |

No significant difference exists in the degree of development of calculus deposits in male and female adults, although the Kolmogorov-Smirnov D statistic reveals a significant (at the 5% level) difference between adults and juveniles, presumably reflecting the lesser time for deposits to accumulate on the teeth of juveniles. No significant difference exists in the degree of development of calculus deposits between the Blackfriars and the School Street Anglo-Saxon material.

(v) Dental enamel hypoplasias. These appear macroscopically as linear bands of depressed enamel or bands of pitting (Sarnat & Schour 1941). They are associated with a wide variety of stressors including infectious diseases and nutritional deficiencies (Pindborg 1970: 138-210). The anterior dentition appears to be more susceptible to hypoplasias than the posterior teeth (Goodman & Armelagos 1985). One hundred and forty-nine individuals had anterior permanent dentition in a sufficiently unworn state for hypoplasias to be scored. The results are shown below.

| Table 39: Dental enamel hypoplasias | | | | |
|---|---|---|---|---|
| Number of defects | | | | |
| | 0 | 1 | 2 | 3 |
| Male adults | 56 | 21 | 9 | 6 |
| Female adults | 31 | 3 | 7 | 1 |
| All adults | 88 | 24 | 16 | 7 |
| Juveniles | 8 | 5 | 1 | 0 |

The difference with respect to presence/absence of defects or with respect to number of defects between the sexes is not significant, although males do have a slightly greater number of defects in both respects; this pattern might be expected in view of the growing male's greater vulnerability to environmental stress (Stinson 1985). In some studies of archaeological material (e.g. Goodman & Armelagos 1988; Rose et al. 1978) an earlier age at death was found for individuals with hypoplastic defects, suggesting that those vulnerable to stress in childhood were also vulnerable in later life, or that stress during childhood may have compromised their ability to fight later infections. This pattern was not evident in the present material, either in terms of the adult age at death or in terms of the number of individuals dying in childhood. This suggests that the episodes which gave rise to the hypoplasias were generally of a fairly trivial and transient nature. Long-bone growth was studied in order to investigate further the growth of the juvenile skeleton. Although few juveniles could be aged by dental development and had long-bones intact for measurement, the older children often tended to have somewhat greater long-bone lengths at a given age than other archaeological series (e.g. Mays 1985) and were similar to, or somewhat greater than, those given for a mid 20th century series by Maresh (1955). Thus the long-bone growth evidence (despite the fact that, obviously, it relates to individuals who failed to survive childhood), such as it is, tends to support the dental enamel hypoplasia data in suggesting a generally fairly healthy childhood.

The frequency of enamel defects is similar to that in the Anglo-Saxon School Street assemblage.

The position of a defect on a tooth was used to estimate the age at which the individual suffered the stress episode which gave rise to the hypoplasia, using the methodology of Goodman et al. (1980). The number of hypoplasias in the present assemblage is greatest in the 2-4 year age group. It is tempting to link this peak with problems associated with weaning, however Goodman & Armelagos (1985) suggest that different parts of the tooth crown may differ in their susceptibilities to hypoplasias; this would clearly influence distribution of defects on a tooth.

It was not generally possible to obtain an indication of the precise cause of the enamel defects in individual cases in the Blackfriars material. There are a few possible exceptions to this. The dentition of burial 2577 (possibly female, aged about 11) showed severe which developed at about 3.2-3.5 and 3.6 years of age. This skeleton shows classic signs of spinal tuberculosis (see below); in the pre-antibiotic era tuberculosis was predominantly acquired during infancy and early childhood (Ortner & Putschar 1985). It seems possible that the marked hypoplastic defects noted on the dentition of this individual mark the onset of the infection. Burial 1340 (female aged 21-23) also shows signs of tuberculosis and displays dental enamel hypoplasias of estimated age of formation of about 2.5 and 3.5 years of age; perhaps these might relate to the onset of the disease.

Burial 0761 (juvenile aged about 8 years) shows severe hypoplastic defects which probably formed in the first year of life. The inner table of the skull shows abnormally prominent markings for the cerebral convolutions, suggestive of increased intra-cranial pressure; it seems possible that the cranial and dental lesions are associated - a possible cause of the cranial lesions is hydrocephalus, a condition generally acquired during the first 6 months of life (Manchester 1980).

(vi) Impacted and embedded teeth. The mandibular 3rd molars of 1469 (probably male aged 20-25) are impacted against the M2s, as is the right mandibular M3 of 2535 (male aged 21-24). The right maxillary canine of 2451 (male 22-25) has failed to erupt and the deciduous tooth is retained; the unerupted canine is visible through the incisive fossa and appears to be orientated medially. The left maxillary deciduous canine is also retained, the permanent tooth erupting alongside it. The right mandibular canine is unerupted and the deciduous tooth has been retained. The left maxillary canine of 3109 (male aged 25-35) is unerupted.

(vii) Dental trauma. Six individuals show evidence for ante-mortem dental chipping. This was differentiated from post-mortem fracture by examination of the fractured edges - smoothing suggests attrition of the broken edges and hence in-vivo chipping.

Table 40: Dental chipping

| Burial | Site of dental trauma |
|---|---|
| 1483 (male aged 30-40) | Left maxillary I2 |
| 1816 (male aged 35-50) | Left maxillary canine and I2 |
| 2333 (female aged 50+) | Right mandibular PM1 |
| 2620 (male aged 30-40) | Left mandibular M2 |
| 2640 (male aged 40-60) | Right maxillary I2 |
| 2650 (male aged 35-45) | Left mandibular canine |

Most of the cases of dental trauma involve anterior teeth, as might be expected since they are most exposed to damage via a fall or a blow. Posterior teeth may be chipped as a result of chewing upon some hard object inadvertently taken in with the food. In 2 cases the fracture has exposed the pulp cavity of the tooth. In 1483 the chipping of the I2 has led to the formation of a periapical abscess. The neighbouring medial incisor has been lost ante-mortem, probably as a result of the same traumatic incident which caused the fracture of the I2. The fracture of the premolar of 2333 looked suspiciously "post-mortem" under low power microscope (i.e. it had rather sharp edges), however the presence of an alveolar abscess at the socket of this tooth testifies that the fracture was an ante-mortem event.

(viii) Periodontal disease. Periodontal disease is an inflammation of the gums and other periodontal tissues associated with poor oral hygiene. The manifestations of the disease in skeletal material are porosis and profile changes to the interdental septa, and infra-bony pockets may form in severe cases (Costa 1982). Alveolar resorbtion may accompany these changes, but apparent alveolar resorbtion alone is an insufficient basis upon which to form a diagnosis: as they wear during adult life the teeth continue to erupt in order to maintain occlusion: this gives the misleading appearance of recession of the alveolar bone (Whittaker et al. 1985).

There are 50 cases of periodontal disease among the Ipswich Blackfriars material, 38 males and 12 females. In most cases the disease is widespread in the dental arches but in those cases where the disease is localised, the more posterior parts of the mouth tend to be those affected, and when the whole mouth is affected severe lesions are more likely to occur in the posterior parts of the dental arches.

***b) Arthropathies***

(i) Degenerative joint disease: osteoarthritis and spinal osteophytosis (spondylosis deformans). Although the aetiology of osteoarthritis and spondylosis deformans must be considered multifactorial, both human and animal studies have shown that mechanical stress upon the joints plays an important role (Radin et al. 1980; Kellgren & Lawrence 1958; Kellgren 1961). The most usual cause seems to be repeated minor traumata, as might result from day to day activities (although it may occur as a consequence of a single trauma to a joint). Consistent with this, studies of human populations have shown that the prevalence of these 2 conditions varies with individual age and the amount of physical stress to the joints in life (op. cit).

At a synovial joint mechanical stress leads to degeneration of the joint cartilages, with subsequent macroscopic bony changes, including marginal spurring and joint surface irregularities.

At the amphiarthrodial joint between the vertebral bodies mechanical stress may lead to displacement of the intervertebral disc, which in turn causes traction at the sites at which it attaches to the vertebral body; this leads to formation of osteophytes at the margins of the vertebral centra. In addition to their attachments to the margins of the vertebral body, the discs are also attached to the cartilaginous end plate of the centrum; this cartilage may also undergo degenerative changes, in a similar fashion to the cartilage in a synovial joint, resulting in analogous bony changes.

Osteoarthritis and spinal osteophytosis were distinguished from other arthropathies using criteria described by Rogers et al. (1987) and Resnick (1985).

The presence of osteoarthritis and spinal osteophytosis was scored into 3 grades, according to the extent of the bony changes, using to the scheme of Sager (1969, reproduced in Brothwell 1981: Fig. 6.9). Individuals showing erosive arthropathies and those showing advanced DISH (see below) were excluded from the figures (for adults only) shown in Tables 41-44.

Table 41: Spinal osteophytosis: maximum severity by individuals

| Maximum severity | | | |
|---|---|---|---|
| 0 | I | II | III |
| 40 | 82 | 37 | 14 |

Table 42: Spinal osteophytosis: prevalence by vertebrae

| Cervical | | | | Thoracic | | | | Lumbar | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | I | II | III | 0 | I | II | III | 0 | I | II | III | 0 | I | II | III |
| 348 | 114 | 77 | 24 | 658 | 599 | 31 | 6 | 348 | 269 | 37 | 5 | 1354 | 982 | 145 | 35 |

Table 43: Osteoarthritis: maximum severity by individuals

Maximum severity

| | | | |
|---|---|---|---|
| 0 | I | II | III |
| 61 | 70 | 35 | 45 |

Table 44: Distribution of osteoarthritis

| Skeletal element | Severity 0 | I | II | III |
|---|---|---|---|---|
| L mandibular condyle | 77 | 5 | 0 | 1 |
| R mandibular condyle | 85 | 1 | 1 | 0 |
| L ribs | 922 | 159 | 28 | 4 |
| R ribs | 873 | 155 | 37 | 4 |
| Cervical vertebrae | 565 | 72 | 30 | 55 |
| Thoracic vertebrae | 1189 | 144 | 58 | 55 |
| Lumbar vertebrae | 541 | 72 | 16 | 22 |
| L medial clavicle | 102 | 10 | 2 | 1 |
| L lateral clavicle | 76 | 15 | 7 | 2 |
| R medial clavicle | 89 | 13 | 1 | 1 |
| R lateral clavicle | 73 | 22 | 9 | 0 |
| L glenoid cavity | 114 | 24 | 1 | 2 |
| R glenoid cavity | 111 | 28 | 1 | 1 |
| L proximal humerus | 137 | 2 | 0 | 2 |
| R proximal humerus | 132 | 1 | 1 | 1 |
| L distal humerus | 142 | 6 | 1 | 2 |
| R distal humerus | 143 | 6 | 0 | 1 |
| L proximal radius | 132 | 3 | 1 | 1 |
| R proximal radius | 139 | 4 | 0 | 0 |
| L distal radius | 125 | 11 | 0 | 1 |
| R distal radius | 136 | 9 | 0 | 1 |
| L proximal ulna | 120 | 30 | 1 | 1 |
| R proximal ulna | 118 | 37 | 1 | 0 |
| L distal ulna | 108 | 12 | 0 | 1 |
| R distal ulna | 120 | 10 | 1 | 0 |
| L carpals | 636 | 19 | 4 | 6 |
| R carpals | 724 | 19 | 6 | 7 |
| L metacarpals | 683 | 10 | 5 | 1 |
| R metacarpals | 721 | 10 | 9 | 2 |
| L hand phalanges | 824 | 39 | 2 | 5 |
| R hand phalanges | 944 | 44 | 10 | 9 |
| U hand phalanges | 498 | 16 | 2 | 3 |
| L acetabulum | 115 | 37 | 4 | 2 |
| R acetabulum | 119 | 38 | 3 | 2 |
| L proximal femur | 152 | 11 | 0 | 3 |
| R proximal femur | 151 | 11 | 2 | 3 |
| L distal femur | 144 | 13 | 1 | 4 |
| R distal femur | 148 | 15 | 2 | 1 |
| L patella | 90 | 19 | 2 | 2 |
| R patella | 89 | 20 | 2 | 1 |
| L proximal tibia | 144 | 10 | 1 | 2 |
| R proximal tibia | 141 | 15 | 1 | 0 |

| Skeletal element | | Severity 0 | I | II | III |
|---|---|---|---|---|---|
| L distal tibia | 169 | 2 | 1 | 0 | |
| R distal tibia | 167 | 2 | 0 | 1 | |
| L proximal fibula | | 51 | 2 | 1 | 0 |
| R proximal fibula | | 63 | 3 | 0 | 0 |
| L distal fibula | 144 | 0 | 0 | 0 | |

| | | | | | |
|---|---|---|---|---|---|
| R distal fibula | 145 | 0 | 1 | 0 | |
| L calcaneus | 174 | 0 | 0 | 0 | |
| R calcaneus | | 171 | 6 | 0 | 0 |
| L talus | | 167 | 2 | 2 | 0 |
| R talus | 163 | 4 | 1 | 2 | |
| L tarsals* | 679 | 8 | 6 | 2 | |
| R tarsals* | 718 | 5 | 4 | 2 | |
| L metatarsals | | 771 | 12 | 4 | 4 |
| R metatarsals | | 763 | 11 | 12 | 5 |
| L foot phalanges | | 445 | 6 | 3 | 0 |
| R foot phalanges | | 510 | 5 | 2 | 2 |
| U foot phalanges | | 270 | 0 | 1 | 0 |

L=left R=right U=unknown side *=excluding talus and calcaneus

The numbers of individuals showing osteoarthritis and spinal osteophytosis to the various degrees of severity do not differ significantly between the sexes, and the distributions of osteoarthritis and osteophytosis in the skeleton are also similar. The distribution of lesions in the skeleton is similar to that in the Anglo-Saxon assemblage from the School Street site, although both conditions were rather more frequent and more severe in the Blackfriars material, reflecting the older adult age at death.

Resnick (1985) claims that spinal osteophytosis is found in about 60-80% of individuals aged over 50. The present data suggest at least this frequency of the disease in the Blackfriars people - of 43 individuals probably aged over about 50 years with 1 or more vertebrae present for study, all but 1 show bony signs of the disease.

(ii) Diffuse Idiopathic Skeletal Hyperostosis (DISH). This is a progressive ossification of the spinal ligaments and extra-spinal soft tissues; it occurs in middle-aged and elderly individuals and its precise aetiology is uncertain. In skeletal material it is characterised by massive, flowing osteophytes on the anterior/lateral parts of the vertebral bodies, which tend to be right-sided in the thoracic spine (probably reflecting the inhibiting effect on bone formation on the left side of the vertebral bodies due to the presence of the descending aorta), ossification at the enstheses (particularly on the iliac crests, the insertions of the quadriceps femoris on the patellae, the olecranon processes and the insertions of the Achilles tendons on the calcanei) and, to a lesser extent, at the margins of joints which show no other changes. The disease leads to fusion of vertebrae and, frequently, to bony bridging of the sacro-iliac joints (Rogers et al. 1987; Resnick 1985; Brigode et al. 1982). The spinal changes in burial 1417 are shown in Plate 2.
Rogers et al. (1987) state that DISH is only diagnosed in clinical practice if at least 3 contiguous vertebrae are fused and extra-spinal manifestations are present, but point out that earlier changes of DISH will be visible on dry bones. The bony changes in probable cases of DISH in the Blackfriars assemblage are summarised in Table 45.

Table 45: Diffuse idiopathic skeletal hyperostosis (DISH)

| Burial | Fused vertebrae | Vertebrae showing ossification of spinal ligaments without ankylosis | | Extra-spinal ossifications |
|---|---|---|---|---|
| 0740 (male aged 30-40) | - | T5 & 6, T8 & 9, L6 | Yes | |

| | | | | |
|---|---|---|---|---|
| 1068 (male aged 35-45) | - | T4 & 5, T9-12 | Yes | |
| 1417 (male aged 60+) | T3-11 | T12 & 1 cervical vertebra | | Yes |
| 1418 (male aged 40-50) | 2 lower thoracics | Several thoracic vertebrae | | Yes |
| 1457 (female aged 35-45) | 3 middle thoracics | T12, 1 other thoracic & 4 lumbar, & the 1st sacral vertebra | | Yes |
| 1757 (male aged 40-50) | T2-5, T10-12 | L1, 2 & 5; S1 | | Yes |
| 1799 (male aged 50+) | 4 thoracics (?9-12) & 2 other thoracics | L1-5 | | Yes |
| 1816 (male aged 35-50) | - | T6-10 | | Yes |
| 1834 (male aged 50+) | T5-9 (& T10-12?) | L1-5 | | Yes |
| 1882 (male aged 30-50) | T11 & 12 | - | | Yes |
| 1892 (male adult) | T8 & 9 | L4 & 5 | | Yes |
| 1985 (male aged 35-45) | - | T7-9 | | Yes |
| 1987 (female aged 50+) | - | Several middle thoracic vertebrae | | Yes |
| 2005 (male aged 35-45) | T6-7 & T9-11 | Most thoracic and lumbar vertebrae | | Yes |
| 2396 (male aged 40-60) | T10 & 11 (& T9) | T4-6, T7-9 | | Yes |
| 2466 (male aged 40+) | T9 & 10 | - | No | |
| 2478 (male aged 30-50) | 2 thoracics | 2 thoracic vertebrae | Yes | |
| 2496 (male aged 45-55) | 3 middle/upper thoracics | 4 thoracic, 1 lumbar vertebra | | Yes |
| 2591 (male aged 35-45) | T5-11 | - | Yes | |
| 2647 (male adult) | T3-10 | T2 & T11, 2 lumbar vertebrae | Yes | |
| 2654 (male adult) | T4-L1* | C5 & C6, T3 & T4, some lumbar vertebrae | | Yes |

* 2654 has 13 thoracic vertebrae so this represents ankylosis of 11 vertebrae.

There are thus 21 individuals showing bony changes which are probably associated with DISH, but only 10 meet the criteria described by Rogers et al. (1987) for clinical diagnosis of the condition. In modern populations DISH is rare in individuals aged under 40, although incipient signs may be observed in those aged 20-40 (Resnick & Niwayama 1988: 1566f). The age distribution of those individuals in Table 45 is consistent with this. Resnick & Niwayama (1989: 1566) indicate that 60-75% of modern cases of DISH occur in males. The Blackfriars data are consistent with this: of the 21 individuals in Table 45, 19 are male and only 2 are female. The difference in frequency of DISH between males and females (with one or more vertebral bodies available for study - 120 males, 58 females) is significant at the 2% level according the the chi-square test.

The prevalence of DISH in individuals aged 40 years or more in a modern population is 2.8% (Julkunen et al. 1971). In the Blackfriars assemblage the prevalence (scored according to the criteria of Rogers et al. 1987) among adults thought to be aged about 40 years or older who had 3 or more vertebrae available for study (N=67) is 13.4%. Thus the prevalence at the Ipswich Blackfriars site is very much greater than expected from modern figures (the real prevalence would probably have been greater than 13.4% - the incomplete nature of the vertebral columns makes under-estimation of its prevalence likely). Although its precise aetiology is uncertain, increased frequency of DISH has been associated with obesity (Julkunen et al. 1971); Waldron (1985) suggested that the high prevalence of DISH which he found in a (fairly small) series of skeletons from Merton Priory might be explained by obesity among the religious orders, a likely possibility, Waldron suggests, in view of documentary accounts of over-enthusiastic consumption of food among Mediaeval monks and friars. Although one would not wish to press the evidence too far, perhaps the high prevalence of DISH in the Ipswich Blackfriars assemblage suggests obesity may have been a problem among the friars and wealthy benefactors buried there.

In contrast with the present material no suggestion of DISH was found among the 51 adults with vertebrae available for study from the 10th-11th century cemetery on the School Street site. This suggests differences in life style between the 2 groups - perhaps, obesity was not a problem for those buried in the 10th-11th century cemetery.

(iii) Erosive arthropathies. These are a group of joint diseases which, in the lesions of the joints, bone resorbtion predominates over bone proliferation. They include gout, rheumatoid arthritis, ankylosing spondylitis, colitic arthropathy (arthritis associated with inflammatory bowel disease), Reiter's disease (an arthropathy which may arise from sexually acquired or gastro-intestinal infections) and psoriatic arthropathy (arthritis associated with psoriasis).

In the Blackfriars assemblage 6 possible cases of erosive arthropathies were identified. Brief descriptions of lesions, together with, where possible, suggested diagnoses are given below.

Burial 0985 (male aged 40-60, skeleton about 40-60% complete). The head of the right 1st metatarsal is largely destroyed by erosive lesions, so that the bone is 1.5cm shorter than its left foot counterpart. The distal part of the right 4th metatarsal has been destroyed, the distal part of the shaft tapering from the sides to a "knife-edge" deformity (Plate 3). There is a small erosion in the head of the left 1st metatarsal. Several metatarsals show periostitis, as do the lower leg bones and the lower part of the shaft of the left femur; that on the tibiae and fibulae tends to follow the ridges for muscle attachments and the attachment for the inter-osseous membrane (Plate 4). The articulations between the patellae and the lateral condyles of the femora are eburnated. The entire spinal column and the sacro-iliac joints are missing; a few hand bones are present and are normal. This appears to be a proliferative erosive arthropathy. A more precise diagnosis is hampered by the incomplete nature of the remains.
Burial 1754 (female aged 30-40, skeleton 40-60% complete). There are erosive lesions on the distal joint surfaces of the left radius and ulna, all 8 left carpals, the proximal joint surfaces of the left 2nd-5th metacarpals and on the distal joint surfaces of 2 proximal left hand phalanges. Only a few fragments of the right hand and wrist bones remain; the radius shows an erosive lesion which has destroyed the ulnar facet and part of the facet for the scaphoid. The erosions show negligible sclerosis at their margins and their internal dimensions are larger than those at the point at which they breach the joint surface. Their internal surfaces are of trabecular bone (Plates 5, 6 & 7). The rest of the skeleton (which is rather incomplete, although most of the vertebral column and the sacro-iliac joints are present) shows no further erosive lesions. The changes at the hands and wrists are suggestive of rheumatoid arthritis (McCarty 1989; Jensen & Steinbach 1977).

Burial 1827 (male aged 40+, skeleton 20-40% complete). There is fusion of the upper third of the right sacro-iliac joint (Plate 8). There is destruction of both faces of the right 5th metatarso-phalangeal joint and slight periostitis of the shafts of the right 4th and 5th metatarsals and on the distal parts of the right fibula (the right tibia is missing). Two vertebrae and one hand bone are present and are normal. Probably an erosive arthropathy.

Burial 2306 (male adult, skeleton 40-60% complete). Two mid-thoracic vertebrae are fused at their centra (with negligible osteophyte formation) and at their facet joints. A small fragment shows that 2 other thoracic vertebral centra were fused in a similar fashion. The remainder of the vertebral column is poorly preserved and very fragmentary, but some vertebrae show erosions of the rib facets on their bodies or transverse processes and there is ankylosis between an upper thoracic vertebral body and the head of a rib. A few ribs show erosive lesions on their articular surfaces with the vertebrae. Of the sacro-iliac joints only the iliac face of the left is present; it is normal except for degenerative changes, as are the hand and foot bones. Probably an erosive arthropathy.

Burial 2466 (male aged 40+, skeleton 40-60% complete). Of the hand bones only 2 proximal phalanges are present; both show erosive changes at their distal ends (Plate 9). One shows complete destruction of its distal joint surface with a hook-like overhanging edge, the other shows marginal erosions. Both faces of the left acromio-clavicular joint are destroyed by erosive changes. The surfaces of all these lesions are of somewhat sclerotic trabecular bone. Most of the vertebral column and the left sacro-iliac joint are present and show no erosive changes. The foot bones are missing. The hook-like overhanging edge of the lytic lesion in the phalanx and the probable lack of involvement of the axial skeleton are suggestive of gout (Resnick & Niwayama 1989: 1619-1671; Martel 1968).

Burial 2656 (male adult, skeleton less than 20% complete). The right 1st and 2nd metatarsals and the medial and intermediate cuneiforms are fused together. The joint surfaces of the right cuneiforms and navicular show florid marginal lipping and erosive changes. Most of the right cuboid has suffered destruction ante-mortem, leaving only a small fragment. All the right metatarsal joint surfaces for which observations can be made (distal 1st and 5th, proximal 2nd-5th) show erosions and marginal proliferation. The proximal phalanx of the 4th toe has an erosive lesion on its distal joint surface. There is heavy spurring at the point of insertion of the Achilles tendon on the right calcaneus. The left lateral cuneiform, cuboid and navicular are fused together, as are the left 2nd metatarsal and medial and intermediate cuneiforms. All the left tarsals show florid osteophytes near their joint surfaces, save the articulation between the 1st metatarsal and the medial cuneiform which is normal. With the above exception, all joint surfaces on the left metatarsals for which observations can be made (proximal 1st and 3rd-5th, distal 1st and 5th) show erosions and marginal proliferation. The proximal phalanx of the left 5th toe shows destruction of its base and that of the 4th shows an erosion on its distal joint surface. There is bony spurring at the insertion of the Achilles tendon on the left calcaneus.

(The changes to the foot bones are shown in Plate 10). A distal and a proximal foot phalanx of indeterminate side are also present; the former shows erosions on its joint surface, as does the latter at its distal articular surface. Of the lower leg bones only the right fibula is present; its distal joint surface shows an erosive lesion. Only 2 hand bones are present, the left 2nd and the right 5th metacarpal, both show erosions at their distal ends (Plate 11). The joint surfaces of the right forearm bones and the distal joint surface of the right humerus show florid marginal lipping and there is spurring on the olecranon process and the radial tuberosity. The surfaces of the erosions are of trabecular bone and show negligible sclerosis. Two middle thoracic vertebrae which are probably from this burial are fused at the margins of their centra by a smooth osteophyte; their facet joints are normal. Very few additional bones are present from this skeleton. This seems to be a proliferative erosive arthropathy which affects the extremities in a bilateral and, at least in the case of the feet, a symmetrical manner; a more precise diagnosis is precluded by the very incomplete nature of the remains.

In distinguishing the various erosive arthropathies the distribution of lesions within the skeleton is an important factor; in this light the incomplete nature of all 6 skeletons showing signs of probable erosive arthropathies is particularly unfortunate.

The presence of a probable case of rheumatoid arthritis in the Ipswich Blackfriars assemblage is noteworthy. Some writers have asserted that rheumatoid arthritis is an entirely modern disease (discussion in Dieppe 1989), although a few skeletons from British archaeological sites do show changes which might be interpreted as consistent with a diagnosis of rheumatoid arthritis (e.g. Rogers 1989).

(iv) Aseptic necroses. Three types of aseptic necrosis were identified in the Ipswich Blackfriars assemblage, osteochondritis dissecans, Perthes' disease and Scheuermann's disease. These conditions involve death of a section of bone at a joint through deficient blood supply.

The pathology in osteochondritis dissecans consists of avascular necrosis of the subchondral bone of the joint with eventual cleavage away of the necrotic fragment forming a loose body in the joint (Jacobs 1976: 320f). The evidence for the condition on dry bone is the pit or cleft left in the joint surface after the separation of the necrotic fragment, which tends to be lined with sclerotic bone. Some cases exhibit healing, which manifests itself as infilling of the pit with new bone which frequently rises proud of the normal joint surface (Manchester 1983:69-70).

Diagnosis of osteochondritis dissecans may be difficult in some instances as joint surfaces, particularly in older individuals, often show minor pits or depressions. In order for the lesion to be scored as present a pit or depression lined with sclerotic bone, or a localised raised area of sclerotic bone was required.

Table 46: Osteochondritis dissecans

| Burial | Location of lesion(s) | Healed? |
| --- | --- | --- |

| | | |
|---|---|---|
| 0962 (female aged 50+) | Proximal L radius | No |
| 1361 (male aged 45-60) | Distal L tibia | No |
| | R glenoid cavity | No |
| 1492 (male aged 50+) | Proximal joint surface of R proximal hallucial phalanx | No |
| 1819 (juvenile aged c11) | Distal L tibia | No |
| 1927 (female adult) | Proximal L & R radius | No |
| 1978 (male aged 30-40) | Distal R humerus | Yes |
| 1985 (male aged 35-45) | Trochlear surface of L talus | No |
| 2301 (male aged 30-50) | Trochlear surfaces of both tali | No |
| 2411 (female adult) | Proximal joint surface of L proximal hallucial phalanx | No |
| 2439 (female aged 30-40) | Both patellae | No |
| 2461 (male aged 40-60) | Both patellae | Yes |
| 2476 (male aged 25-45) | Proximal joint surface of R 1st metatarsal | No |
| | Proximal joint surface of L proximal hallucial phalanx | No |
| 2612 (female aged 35-45) | Proximal joint surface of L proximal hallucial phalanx | No |
| 3118 (female adult) | R patella | Yes |

The precise aetiology of osteochondritis dissecans is uncertain but trauma appears to play a part (Jacobs 1976). In modern populations the most frequent sites of lesions are (in descending order) the knee, the ankle and the elbow (ibid.), the location of lesions in the Blackfriars material are, in the main, consistent with this.

Aseptic necrosis of the vertebral epiphyses is termed Scheuermann's disease. This manifests itself in dry bones by erosions at the anterior margins of the vertebral bodies; the eroded areas show marked sclerosis. It generally presents in adolescence (Griffiths 1986). Two individuals show evidence of Scheuermann's disease, 2458 (male aged 21-24) on the 12th thoracic and 1st lumbar vertebrae (Plate 12) and 2489 (male aged 25-35) on the 12th thoracic vertebra.

Perthes' disease is an extensive necrosis of the femoral head. Burials 1892 (male adult) and 1917 (female aged 50+) show probable Perthes' disease. Inhumation 1892 shows bilateral lesions and 1917 changes on the left femoral head only. The lesions consist of flattening of the weight-bearing parts of the femoral heads and obliteration of the pits for the ligamentum teres; X-ray reveals the femoral necks to be of fairly normal length and there is no evidence for displacement of the femoral heads with respect to the axes of the necks (Plate 13). A differential diagnosis is slipped capital epiphysis but the obliteration of the pits for insertion of the ligamentum teres, the lack of displacement of the femoral heads and the normal length of the femoral necks all argue for Perthes' disease (Ortner & Putschar 1985: 238-242).

Perthes' disease is a disease of childhood; it generally presents between 4 and 7 years of age, 80% of cases are male and in 90% lesions are unilateral (Wynne-Davis & Gormley 1978). It is thus probable that both 1892 and 1917 had the condition from childhood. In both cases there is severe osteoarthritis at the affected hip(s), the severity of the changes testifying to the longstanding nature of the disease. The causes of Perthes' disease are uncertain but it may be initiated by trauma and there appears to be a constitutional disposition (ibid.).

(v) Hallux valgus. Habitual wearing of footwear which constricts the toes may lead to lateral deviation of the big toe - hallux valgus - frequently with a bunion over the medial aspect of the 1st metatarso-phalangeal joint (Barnett 1962; Shine 1965). Its manifestations in dry bones include a smooth-walled cystic cavity near the medial margin of the distal joint surface of the 1st metatarsal and lateral deviation of the proximal hallucial phalanx. Osteoarthritic changes at the 1st metatarso-phalangeal joint are also common (Plate 14).

In the Blackfriars assemblage 16 individuals (13 males, 3 females) showed hallux valgus, all were adult. Thus it would seem that it was mainly males who wore shoes which constricted the toes. It is notable that no instances of hallux valgus were found in the 10th-11th century School Street skeletons, suggesting that constricting footwear was not habitually worn by this group. Further skeletal evidence for the wearing of constricting footwear is provided by 3 individuals (all male) who showed evidence of the type of 5th metatarsal distortion described by White (1988: Fig. 55) or the presence of cystic defects near the 5th metatarsal head analogous to the "bunion erosions" already described for the 1st metatarsal; in one such case hallux valgus was also present. Mediaeval artistic representations and archaeological finds show that footwear which must have constricted the toes was worn in the Mediaeval period (e.g. Steane 1985: 282-3).

(vi) Miscellaneous joint disease. Burial 0938 (male aged 50+, skeleton 80%+ complete). The bodies of many vertebrae bear deposits of sclerotic bone upon their superior and inferior surfaces, and 5 thoracic and 1 lumbar vertebra show Schmorl's nodes, some of which are very large. The 4th and 5th lumbar and the 1st sacral vertebra are fused together (Plate 15) at their bodies by calcification in the disc spaces, and at the right facet joint (L4/5) and the right transverse processes (L5/S1).

There is very severe osteoarthritis of the hips (the left of which also shows a slipped capital epiphysis) and, particularly, the shoulders (Plate 16), although changes in the remainder of the skeleton are generally fairly slight.

There is bony spurring at many sites, including the pubic symphyses and the iliac crests. In addition to ossification of the thyroid there are several unidentified soft tissue calcifications.

The severity of the osteoarthritis at the shoulders is unusual, particularly coupled with the relative lack of severe osteoarthritic changes in most of the rest of the skeleton, and in the absence of any evidence for local trauma, suggests a need to search for other disorders as a cause (Resnick & Niwayama 1988: 1408). The intervertebral calcification, the formation of Schmorl's nodes, fusion of lower vertebrae and marked osteoarthritis at major joints with little peripheral involvement are all features of ochronotic arthropathy, a condition which is a result of alkaptonuria, an inherited metabolic disorder in which a black pigment is deposited in the cartilage of the intervertebral discs and synovial joints resulting in severe degenerative changes at the discs and major joints (O'Brien et al. 1963; Martin et al. 1955; Schumacher 1989). However the radiographic appearance of the vertebral column is not typical of ochronosis (Guyer pers. comm), hence the cause of the lesions in 0938 remains uncertain.

***(c) Trauma***

(i) Fractures. A total of 41 adults show 80 fractured bones. The overall fracture rate with respect to bones (adults only) is 80/21118=0.38%. No fractures were found in juveniles.

Table 47: Fractures

| Burial | Fractures |
|---|---|
| 0950 (male aged 60+) | Body of L4, L humerus (d 1/3), R femur (sub-trochanter, un-united) |
| 0974 (male aged 22-25) | R rib (through articular facet), R humerus (fissure fracture of greater trochanter) |
| 0985 (male aged 40-60) | R radius (Colles' fracture) |
| 0992 (male aged 25-35) | Skull, weapon injury |
| 1012 (male aged 40-50) | 7 L middle true ribs (8 fractures, 1/3-1/2 way from sternal ends) |
| Burial | Fractures |
| 1376 (female aged 30-50) | R middle rib (5-6cm from sternal end) |
| 1749 (male aged 30-40) | Skull, 2 unhealed weapon injuries |
| 1795 (female aged 45-60) | 2 U rib fragments |
| 1827 (male aged 40+) | L fibula (p 1/3) |
| 1882 (male aged 30-50) | Neural spine of L2 |
| 1892 (male adult) | Neural spine of T4 |
| 1904 (male aged 30-40) | R radius and ulna (d 1/3, amputation) |
| 1914 (male aged 35-45) | Bodies of T11 & 12, R 2nd metacarpal & proximal phalanx, R acetabular rim |
| 1935 (male aged 22-50) | Body of T11, L radius (Colles' fracture), ulna styloid |
| 1944 (male aged 30+) | R femoral neck |
| 1965 (female aged 50+) | 2 lower thoracic vertebral bodies, L clavicle (lat 1/3), U rib fragment |
| 1967 (female aged 22-25) | 1 upper thoracic vertebral body |
| 1978 (male aged 30-40) | Skull (?weapon injury) |
| 1987 (female aged 50+) | 3 U rib fragments |
| 2306 (male adult) | 1 L 2nd metacarpal |
| 2316 (female aged 22-25) | 2 L ribs (3 fractures, 1 un-united in mid-shaft area) |
| 2318 (male aged 25-35) | R radius (d 1/3) |
| 2348 (female adult) | L radius (d joint surface) |
| 2386 (female aged 35-45) | R 2nd, 3rd & 4th metacarpals, R radius (Colles' fracture) |
| 2407 (male aged 35-45) | 2 L ribs (1/3 of way from heads), 1 R rib (midshaft), 2 U rib fragments |
| 2436 (male adult) | R tibia (fragment avulsed at distal interosseous border) |
| 2441 (unsexed adult) | Body of T12 |
| 2452 (female aged 40-50) | Body of a mid-thoracic vertebra |
| 2461 (male aged 40-60) | Skull (depressed fracture) |
| 2476 (male aged 25-45) | Proximal foot phalanx |
| 2480 (male aged 22-30) | 2 U ribs (near sternal ends) |
| 2482 (male aged 35-45) | Body of T12, R 4th metacarpal |
| 2537 (female aged 60+) | Bodies of L1 & L5 |
| 2546 (male aged 50+) | Bodies of L2 & 2 middle thoracic vertebrae |
| 2548 (?male aged 25-35) | Sternum, 2 R ribs (midshaft & between head & tuberosity) |
| 2583 (male aged 50+) | 1 U rib fragment |
| 2628 (female aged 50+) | L ulna midshaft (un-united) |
| 2647 (male adult) | Bodies of T12 & 2 lumbar vertebrae |
| 2650 (male aged 35-45) | Skull (depressed fracture) |
| 3107 (male aged 50+) | L radius (Colles' fracture) |
| 3109 (male aged 25-35) | L tibia (d joint surface) |

Notes: L=left, R=right U=unsided, d=distal, p=proximal, lat=lateral. Fractures united unless stated.

Three burials show evidence of injuries from edged weapons. Burial 1749 shows a cut on the left side of the skull, stretching from the left orbital margin, across the frontal and parietal bones and terminating in the area of the sagittal suture (Plate 17). There is a second, smaller (23mm long) cut on the right parietal, 5-6cm from the coronal and 7-8cm from the sagittal suture.

Neither cut shows any sign of healing and both are very clean with slightly polished surfaces. There is no sign of fragmentation at their edges, suggesting that a very sharp weapon was used. The massive cerebral injury which the main wound must have caused was almost certainly cause of death. Examination of the surfaces of the main lesion under low power binocular microscope reveals fine parallel scratch marks whose orientation suggests that the blow came from directly above the individual.

Burial 0992 shows a wound 4cm long in the left parietal and frontal bones (Plate 18). Its rounded edges indicate healing, and united fractures run from the front and rear edges of the hole. The form of the hole suggests a blow from an edged weapon from above and slightly to the right of the head. It seems probable that the blow resulted in some fragmentation of the bone and that these small fragments were resorbed on healing, leaving the hole. It would seem that the weapon used to inflict this injury was sufficiently sharp to cut the bone but not sharp enough so that a clean cut resulted (i.e. it was less sharp than the weapon that killed 1749). Consistent with this the united fractures radiating from the front and rear of the hole suggest some splitting of the bone as might result from a thicker blade. The state of healing of the lesions suggests that the injury occurred long before death.

Burial 1978 has a linear gully 18mm long running obliquely near the left frontal eminence. The lesion fails to penetrate the cranial vault and has the appearance of a superficial edged weapon injury, perhaps from a blow which failed to land with the intended force, or perhaps 1978 was wearing a helmet or other protective headgear which took most of the force of the impact.

Although not properly a fracture the rather unusual lesion displayed by burial 2491 (male aged 50+) should probably be discussed in this section. There is an iron fragment embedded in the outer table of the left frontal bone (Plate 19). The fragment has a rectangular cross-section and a pointed tip, and it fails to penetrate the full thickness of the calvarium (Plate 20). The fragment appears to be the tip of a weapon, implement or projectile. The bone of the outer table around the fragment is bevelled inwards suggesting that the injury was an in-vivo event (or occurred fairly soon after death while the bone was still fresh). The injury is clearly insufficient to be cause of death.

The skull of 2461 shows a blunt injury which was probably due to inter-personal violence. There is a healed depressed fracture of the left frontal and parietal bones, the focus of which lies about 1.5cm above the pterion (Plate 21). Healed fracture lines radiate from the focus of the lesion and there is some fragmentation at the point of impact, where the bone is depressed inwards by about 1cm. The state of healing suggests prolonged survival. The appearance of the injury suggests a blunt impact over a fairly small area, the trajectory of the blow being from the individual's left and slightly above and in front. There is also an area of roughened bone on the outer table of the frontal bone 3cm to the right of the midline and 1.5cm from the coronal suture; this probably represents superficial trauma to the outer table with subsequent healing.

Burial 2650 also shows a probable healed depressed fracture of the skull. There is an oval depression about 1x2cm on the left parietal bone, with a corresponding bulge on the inner table.

The right hand of burial 1904 has been amputated by an oblique cut through the radius and ulna (Plate 22). Comparison with the left forearm bones suggests that the radius was severed 73mm from the distal end and the ulna 43mm from its distal end. The bones are united in a supinated position by 2 bridges of callus. No trace of a prosthesis was found in the grave. Comparison of the state of the stump with those of modern amputees (Barber 1929; 1930) suggests a quiescent stump with healing complete - amputation may have occurred many years prior to death. From the nature of the stump it is impossible to determine whether amputation was a result of surgical intervention or due to a weapon injury.

The Calendar of Patent Rolls for 1327 records a complaint by Richard de Holebrok that a mob of 84 named individuals (including 2 women and 3 chaplains) "and others", "assaulted him at Tatyngston, co. Suffolk, bound him to a tree and cut off his right hand". Tattingstone is a village about 4 miles from Ipswich. The Holbrook family were Suffolk gentry and floor tiles bearing the Holbrook family crest were found in the excavations at the Blackfriars site. Amputations are only rarely found in British archaeological material, although a few other Mediaeval examples are known (e.g. from the leper cemetery at Chichester and from Cathedral Green, Winchester). The above suggests that burial 1904 may be Richard de Holbrook, but efforts to investigate further this possibility, using documentary data, proved fruitless.

One further fracture which may have been caused by inter-personal violence is the transverse midshaft fracture of the left ulna displayed by 2628. Such fractures are often due to the forearm being raised to parry a blow aimed at the head (Benjamin 1982).

All individuals showing weapon wounds are males (this is usually the case) as are all those displaying injuries probably associated with violence except 2628 which is female.

In his study of the (male) secular peerage of 1350-1500 Rosenthal (1973) found that 19.1% suffered death through violence. Despite the fact that many violent deaths will not be evident on the skeleton, it seems most unlikely that the rate of violent deaths among those buried at the Ipswich Blackfriars was anything like as high. Documentary evidence (Page 1975) suggests a great deal of lawlessness and violence in Suffolk at times during the period the Ipswich friary was in existence, but the skeletons from Ipswich do not seem to reflect a high level of inter-personal violence.

Most fractures seem to have healed with little shortening or malalignment, although this does not necessarily imply splinting or other treatment of injuries - Schultz (1967) found that many fractures sustained by wild-living apes healed with little deformity or shortening. However 2 individuals showed fractures which failed to unite - a rib of 2316 and the mid-shaft ulna fracture of 2628. This last (Plate 23) shows formation of a pseudarthrosis (false joint) at the site of the fracture, together with severe osteoarthritis of the elbow and distal radio-ulna articulation.

No significant difference exists between the proportion of males and females showing fractures.

The rate of fracture with respect to individuals is rather greater than in the 10th-11th century School Street assemblage (18.1% of adults compared with 8.9%), but the difference in frequency with respect to total bones is somewhat less (0.38% compared with 0.25%). The greater difference in frequencies with respect to presence/absence of fractures in individuals is probably associated with the greater skeletal completeness of the Blackfriars burials. A greater frequency of fractures might also be expected in the Blackfriars assemblage on account of the older age at death of adults here (using the years at risk analysis of Lovejoy & Heiple (1981)). A notable difference between the 2 School Street groups is that in the Anglo-Saxon assemblage there were no skull fractures or edged-weapon injuries and only 1 fracture (an ulna "parry" fracture) which might be ascribed to inter-personal violence.

Some individuals showed signs of trauma which did not result in fracture e.g. myositis ossificans circumscripta (an ossification which often arises through trauma), ossified sub-periosteal haematoma (ossification beneath the periosteum which may follow deep bruising) or severe localised osteoarthritis. These cases are described in the entries for individual burials (Appendix). It is notable that these injuries are particularly common in the ankle region in the present series.

(ii) Slipped capital epiphysis. Burials 0938 (male aged 50+), 1786 (male aged 35-45) and 1955 (male aged 50+) show probable slipped femoral capital epiphyses; 0938 and 1786 show unilateral lesions on their left and right femora respectively (Plate 24), 1955 shows bilateral changes. Lesions include inferior/posterior displacement of the femoral head and shortening of the femoral neck. All cases show severe osteoarthritis.

Slipped capital epiphysis is a stress failure of the epiphysial cartilage in the growing bone. It is most frequent between the ages of 12 and 17 years and is more prevalent in males than females. In some cases slippage seems to be initiated by trauma but in many instances no history of trauma can be obtained. There seems to be a constitutional predisposition to the condition, it being more frequent in obese boys with delayed sexual maturity and in adolescents with a history of rapid growth, so that the individual is tall and slender (Bedbrook 1982). None of the 3 cases at Ipswich is particularly tall, so perhaps the former scenario is the more relevant.

(iii) Schmorl's nodes. An intervertebral disc consists of a tough outer layer (the annulus fibrosus) surrounding an inner core (the nucleus pulposus) which, until young adulthood, is composed of semi-gelatinous material. In younger individuals excessive compression of the spine, as might occur due to heavy lifting, may result in extrusion of material from the nucleus pulposus into the adjacent vertebral body. The bony manifestation of this is a pit or cleft - the Schmorl's node. In some individuals congenital weakness in the cartilage end plate of the vertebral body may predispose to Schmorl's node formation, but there is no doubt that a single trauma may produce a Schmorl's node in a normal spine (Schmorl & Junghanns 1971: 158-168). No juveniles show Schmorl's nodes; the data for adults is given below.

Table 48: Schmorl's nodes: distribution in the spine

| | TOTAL ADULTS | | | MALES | | | FEMALES | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total vert. | No of vert. with nodes | No of nodes | Total vert. | No of vert. with nodes | No of nodes | Total vert. | No of vert. with nodes | No of nodes |
| Cervical vertebrae | 594 | 0 | 0 | 401 | 0 | 0 | 191 | 0 | 0 |
| Thoracic vertebrae | 1321 | 160 | 175 | 897 | 137 | 147 | 418 | 17 | 20 |
| Lumbar vertebrae | 670 | 49 | 55 | 438 | 42 | 47 | 224 | 7 | 8 |

Table 49: Schmorl's nodes: frequencies by individuals

| | With | Without |
|---|---|---|
| Males | 66 | 54 |
| Females | 13 | 45 |
| Total adults | 69 | 112 |

The difference in frequency between the sexes with respect to presence-absence of nodes in individuals is significant at the 0.1% level by chi-square, with males having the greater frequency. Although prevalences with respect to vertebrae are not amenable to statistical analysis, the prevalence for males is considerably greater than that for females. These results suggest greater strain was placed upon the vertebral column in young males.

The prevalence of Schmorl's nodes in the 10th-11th century School street adults was lower both with respect to total vertebrae (4.2% of thoracic vertebrae and 4.6% of lumbar vertebrae compared with 12.1% and 7.3% respectively in the Blackfriars assemblage) and with respect to presence/absence in individuals (13.9% compared with 38.1% of the Blackfriars adults) the latter difference being significant at the 0.1% level by Chi-square. This implies a greater stress to the spine during adolescence and early adulthood in the 13th-16th century individuals than among their 10th-11th century predecessors.

***(d) Porotic hyperostosis***

Cribra orbitalia (porotic hyperostosis of the orbital roofs) takes the form of small pits or perforations in the orbital roofs. The condition was scored using the scheme of Brothwell (1981: Fig. 6.17).

Table 50: Cribra orbitalia

| | Absent | Porotic | Cribriotic | Trabecular |
|---|---|---|---|---|
| Males | 85 | 18 | 5 | 5 |
| Females | 39 | 4 | 4 | 1 |
| Total adults | 125 | 22 | 9 | 6 |
| Juveniles | 13 | 1 | 3 | 0 |

Burial 1855 (male aged 22-25) shows "labyrinth" lesions on the inner table of the occipital, parietal and frontal bones and 2458 (male aged 21-24) shows pitting of the external table of the right parietal and frontal bones in the region of the coronal suture. It seems probable that these represent instances of porotic hyperostosis of the cranial vault - cribra cranii. Both these individuals also show cribra orbitalia.

It seems that cribra orbitalia and cribra cranii share a common aetiology: anaemia (Hengen 1971; Stuart-Macadam 1989). It also seems likely that the lesions in the orbital roofs represent initial changes whereas severe or prolonged anaemia leads to additional lesions in the cranial vault (op. cit.). Iron deficiency anaemia is the most common anaemia in all parts of the world (Steinbock 1976: 230). In addition to deficient dietary intake of iron, iron deficiency anaemia can be caused by gut parasites, frequent in unhygienic conditions which were no doubt prevalent in antiquity.

There is no significant difference in the prevalence of porotic hyperostosis between adults and juveniles or between males and females in the Blackfriars assemblage, nor between the Blackfriars and the Anglo-Saxon School Street skeletons.

***(e) Infections***

(i) Non-specific infection. When it is not possible to identify a particular micro-organism as responsible for an inflammation it is termed a non-specific infection. In the Ipswich Blackfriars material 2 types of non-specific infection are found: periostitis, inflammation of the periosteum which results in the laying down of new bone upon the underlying cortex, and osteomyelitis, inflammation involving the marrow cavity (Steinbock 1976: 60).

At the Ipswich Blackfriars 37 individuals (22 males, 10 females and 5 infants) show non-specific periostitis. Periostitis may be a response to systemic disease or to local infection. In the latter case the lesions are generally restricted to a single bone or area of the skeleton. Of the 32 adults showing periostitis it affects the bones of the lower legs in 27 cases. The severity ranges from slight pitting and striation to marked swelling of the affected bones with, in one case (1978 (male aged 30-40), a flat oval plaque betraying the presence of skin ulceration, (Plate 25) but most displayed relatively slight changes.

Documentary evidence (Loudon 1981) shows that infection of the lower legs, probably initiated by trauma, was common in the Post-Mediaeval period. The frequency of non-specific periostitis of the lower legs in the Blackfriars material (13.2% of adults with one or both tibiae present) suggests that lower leg inflammation was frequent in this 13th-16th century group. Loudon (1981) shows that lower leg infections in the Post-Mediaeval period were frequently chronic (with ulceration) and resistant to treatments then known, so that they were a common health problem, particularly among the lower social classes. He suggests that a reason for the chronic nature of the lesions may have been dietary deficiency of ascorbic acid (vitamin C) through a lack of fresh fruit or vegetables in the diet. The relatively slight nature of most lesions in the Blackfriars material suggests that, unlike the scenario which seems common in Post-Mediaeval times, the non-specific infections in the Ipswich Blackfriars' lower legs generally cleared up fairly rapidly, rather than becoming chronic and leading to ulceration. If Loudon's thesis that ascorbic acid deficiency prevented the healing of lower leg infections, and was thus responsible for their often chronic nature, is correct, then the Ipswich data would tend to imply sufficient ascorbic acid in the diet (as a result of sufficient consumption of fresh fruit and vegetables) to allow fairly speedy healing of such lesions.

In 4 of the other adults showing periostitis the lower parts of the femur were involved, again suggesting local infection of the legs as a cause. The remaining case (burial 3051, male aged 30+) showed swelling of the distal ends of the left radius and right ulna and the left 2nd and 3rd metacarpals. The acromion and spine of the left scapula showed periostitis. It seems probable that these lesions are a result of some systemic infection but the very poor preservation and incomplete nature of the remains prevents identification of their cause.

Periostitis of the long-bones, skull vault and orbital roofs is often found in infants as a response to systemic disease (Mensforth et al. 1978). All 5 infants from the Blackfriars showed periostitis of this type.

Two individuals show evidence of osteomyelitis. The distal end of the left 2nd metacarpal of 2306 (male adult, skeleton 40-60% complete) is irregularly swollen and X-ray shows a wall of new bone outside the original cortex, some of which has been removed by remodelling. This bone also shows a healed fracture, just behind the distal joint surface. The distal half of the diaphysis of the right femur of 1923 (male aged about 16 years, skeleton 40-60% complete) is swollen and there is some sub-periosteal woven bone upon the cortex. A radiograph (Plate 26) indicates that this swelling is mainly thickening of the cortex on the medial aspect of the bone and that there is some irregularity of the endosteal surface of the cortex on this side. The (unfused) epiphysis is normal.

In osteomyelitis the pathological process is one of bone destruction, pus formation and bone repair, thus the osteomyelitic bone is enlarged and deformed. Osteomyelitis may arise from local infection following soft tissue injury or via the bloodstream from a primary infection elsewhere in the body (haematogenous osteomyelitis). The fracture of the osteomyelitic metacarpal of 2306 indicates the former as the more likely cause in that case. Haematogenous osteomyelitis generally starts in childhood or adolescence, generally occurs in the long-bones (usually starting at the metaphysis) and is limited to one bone in 80% of cases (data for pre-antibiotic era - Ortner & Putschar 1985: 110). It would seem probable that the lesions in 1923 are osteomyelitis, the changes suggesting a fairly early stage of the infection. The unremodelled nature of the sub-periosteal bone indicates that the infection was active at time of death.

Burials 1495 and 2542 show infections of uncertain cause; the lesions are described in the Appendix.

(ii) Tuberculosis. Burial 2577 (?female aged about 11 years, skeleton 60-80% complete). The 2nd-4th lumbar vertebrae are fused at their facet joints; the bodies of 2 and 3 are almost completely destroyed, with negligible bone regeneration (Plate 27). The superior surface of the body of L4 has suffered some destruction and the anterior wall of the body of the 1st lumbar vertebra also bears a lytic lesion.

Both surfaces of the left sacro-iliac joint of 1340 (female aged 21-23, skeleton 80%+ complete) have been destroyed leaving trabecular bone, which on the iliac surface is highly sclerotic (Plate 28). There is a cavity plugged with new bone on the iliac face and X-ray reveals 2 smaller lytic areas within the wing of the ilium. There is little bone regeneration in the destroyed areas but there is periostitis on the anterior surface of the sacrum.

The lesions in 2577 and 1340 are probably due to tuberculosis. Skeletal tuberculosis is generally a result of secondary infection from lesions in the soft tissues, particularly the lungs, the baccilli reaching the bone via the bloodstream. The baccilli tend to locate themselves in areas of haemopoietic marrow which have high metabolic rates, hence the vertebral bodies are frequent sites of lesions. The lack of bony regeneration, or sinus or sequestrum formation argue for tuberculosis over other bony infections such as osteomyelitis (Ortner & Putschar 1985: 144). The lower thoracic and lumbar spine are particularly favoured sites for lesions. Sacro-iliac involvement is generally an extension of a lumbo-sacral focus (op. cit.:149), but in 1340 the lumbar vertebrae are normal.

(iii) Leprosy. Leprosy manifests itself in the skeleton via changes to the facial, lower leg, foot and hand bones. The facial changes include widening and smoothing of the margins of the pyriform aperture, resorbtion of the anterior nasal spine, recession of the maxillary alveolar process and inflammatory changes on the superior and inferior surfaces of the hard palate. These changes are caused directly by the micro-organism responsible for leprosy, Mycobacterium leprae and in combination are pathognomic of leprosy. In addition cribra orbitalia is a frequent finding in leprosy - lepers frequently suffer from anaemia (Hengen 1971). Changes to the feet and lower legs include resorbtion of the metatarsals from their distal ends, producing a tapered appearance, and resorbtion of the digits commencing at the proximal ends. Changes to the hands occur less frequently than those to the feet and include smoothing of the unguicular process of the distal phalanges, followed by resorbtion of the digits commencing at their distal ends; enlargement of nutrient foramina may also occur. Osteitis/periostitis may be a feature of the changes to the extremities and periostitis of the lower legs is also a frequent feature. The changes to the post-cranial skeleton are not due directly to the action of mycobacterium leprae (and may be imitated by other diseases - Gondos 1972) but are secondary to neurological damage resulting in loss of sensation (predisposing to painless trauma and subsequent infection), paralysis and circulatory disturbance (Lechat 1962; Mo/ller-Christensen 1961, 1974; Patterson 1961; Chhabriya et al. 1985).

At the Ipswich Blackfriars 4 individuals showed evidence for leprosy (Plates 29-31, Table 51).

Table 51: Leprosy

| | Location of pathological changes | | | | |
|---|---|---|---|---|---|
| Burial | Face | Hands | Feet | Tib/fib | Cribra |
| 1914 (male aged 35-45) | Yes | No | Slight | Slight | Yes |
| 1987 (female aged 50+) | Yes | No | Yes | Yes | Yes |
| 2593 (male aged c25) | Yes | No | Slight | Yes | Yes |
| 2624 (male aged 22-25) | Yes | Slight | Yes | Yes | No |

(iv) Treponemal disease. Burial 1965 (female aged 50+, skeleton 60-80% complete) shows an area of irregular thickening on the outer table of the frontal bone (Plate 32), near the midline. The bone in this area is highly sclerotic. To the left and right of this area the frontal bone shows irregular thinning - at the thinnest point a post-mortem defect allows measurement of the thickness of the bone - 1.5mm. The inner table is normal, as are the nasal and facial bones, except perhaps for slight pitting in the maxillary lachrymal groove.

The shafts of the following bones show periostitis, with marked concentric thickening: both tibiae, the right fibula (the left fibula is missing), distal parts of both femora, distal parts of both humeri, distal parts of the right radius (only the distal 1/4 is present), the left ulna, left radius and right 3rd metacarpal; the changes are most marked on the tibiae (Plates 33 & 34); they have several raised plaques of bone upon their subcutaneous surfaces. Some of this new bone formation takes the form of bony spicules with apparent bridging over superficial blood vessels, this pattern being most marked on the lateral surfaces of the tibiae (Plate 35). A post mortem break about one quarter of the way from the distal end of the right tibia reveals that the medullary cavity is partially clogged with cancellous bone. There is a flattened area on the spine of the left scapula suggestive of an overlying skin ulcer.

The entire skeleton shows osteoporosis and hence all bones were markedly radiolucent, but X-ray of the pathological long-bones shows that the endosteal surfaces are rather irregular and in many places the demarcation between cortical and cancellous bone is indistinct. There are small patches of radiolucency within the build up of sub-periosteal new bone.

Thus the lesions displayed by 1965 consist of sclerotic thickening and irregular thinning of the frontal bone, together with diffuse periostitis of most long-bones and one metacarpal. The widespread nature of the lesions is suggestive of a systemic disease rather than localised non-specific infection (of the type which seems to have been responsible for the marked periostitis of the tibiae of 1978), and the absence of cloacae and sequestra, and the widespread nature of the lesions militates against osteomyelitis as a diagnosis. The marked production of new bone and the sparing of the joints and vertebrae in the disease process argue against a diagnosis of tuberculosis. It seems probable that these lesions represent non-gummatous periostitis associated with treponemal infection (Ortner & Putschar 1985: 180f; Steinbock 1976: 86f; Hackett 1983; King & Catterall 1959). Ortner & Putschar (1985: 214) state that the presence of raised plaques, bony spicules which appear to bridge over superficial blood vessels and the absence of cloacae are "very typical of conditions occurring in long bones in known cases of syphilis, and... are not found together in non-treponemal infectious diseases".

The treponemal diseases which may manifest themselves on the skeleton are yaws, venereal syphilis (which may be congenital or acquired) and endemic syphilis. Yaws is a disease of the tropics whereas venereal and endemic syphilis extend into the temperate regions (Brothwell 1970). If it may be assumed that similar distributions of the diseases existed with respect to climatic zones in the past, then the infections to be considered in the present context are venereal and endemic syphilis. Distinguishing endemic syphilis and acquired or congenital venereal syphilis on the basis of skeletal evidence is difficult, however a few points are worth noting: in congenital venereal syphilis destruction of bony and cartilaginous elements of the nose is frequent, and there are often naso-palatine lesions in endemic syphilis (Steinbock 1976: 106, 139); in 1965 the nasal area is normal. The distribution of changes in skeleton 1965 seems more characteristic of venereal than endemic syphilis (ibid.). Thus the lesions in 1965 may be more typical of acquired venereal syphilis than of congenital venereal syphilis or endemic syphilis, but the evidence is not sufficient to distinguish between these 3 possibilities with any confidence.

*Discussion*

The earliest case of leprosy in Britain which can be identified from the more diagnostically reliable facial signs dates to the 7th century (Brothwell 1961), although possible cases showing lesions to the post-cranial skeleton only are known from the 5th and 6th centuries in Britain. Documentary evidence (Clay 1909) suggests that the disease peaked in the Norman period with a subsequent decline, so that it was rare by the 15th century. The find of a leprous skeleton in the Anglo-Saxon School Street cemetery testifies to the presence of the disease in Ipswich in pre-conquest times.

During the Mediaeval period considerable efforts were made to segregate sufferers from the general population by their isolation in leper hospitals, of which there were 3 in the Ipswich area during the period in which the Blackfriars burials were interred (Clay 1909). Leper hospital inmates were generally buried in the cemetery attached to the hospital church (ibid). John of Gaddesden, physician to Edward II declared that "no man is to be adjudged a leper, and separated from the intercourse of mankind, until the figure and form of the face is actually changed" (op. cit.: 60-61). The facial bone changes displayed by the Ipswich Blackfriars lepers indicate that the characteristic facial signs of leprosy would have been apparent in life.

Friars sometimes visited leper hospitals to attend to the lepers' spiritual and physical well-being, for example when barber surgeons performed an operation friars attended "leste hurte ande scathe bee done to the lepers" (Clay 1909: 63). Hence it could be suggested that the lepers at the Blackfriars are friars who contracted the disease, however the presence of a female leper (burial 1987) indicates that this cannot be the whole explanation. Manchester & Roberts (1989) suggest that it is probable that some leprosy sufferers were cared for by their kin rather than being segregated in hospitals; it may be that this explanation is relevant in the present cases, particularly as they probably belong to the wealthier strata of Mediaeval society: the wealthy would be better placed to care for their relatives and keep them from being segregated in hospitals against their will. Alternatively they may have been inmates in local leprosaria whose bodies were removed by their families for burial at the Blackfriars. It was suggested above (p30), on the basis of skeletal evidence, that it is likely that burial 2624 (a leper) and burial 3126 (a skeleton showing no signs of leprosy) share a close genetic relationship. It could be argued that this suggests that, at least in the case of 2624, the leper was buried in the friary with his kin.

It has been suggested that syphilis is a disease brought back from the New World by Columbus and his crew (reviews by Baker & Armelagos 1988; Williams 1932; Brothwell 1970), a suggestion which, it has been claimed, is supported by documentary evidence, and by the presence of archaeological specimens showing signs of syphilis of Pre-Columbian date in the New World whereas there is a lack of such specimens from Europe. In this light it was thought to be of interest to attempt to determine, using a precision radiocarbon date, whether burial 1965 pre- or post-dates 1493 (the year in which Columbus made landfall in Europe on his return from the New World). A date of 380+/-18 BP (UB-3202) corrected to 1459-1487 Cal AD (Stuiver & Pearson 1986) was obtained. This indicates that there is about an 84% chance that the burial pre-dates 1493. The only other published evidence of syphilis in Europe pre-1493 comes from an isolated skull showing signs of the disease from St Helen's-on-the-Walls, York (Dawes 1980) which gave a radiocarbon date of 680+/-80 BP (HAR 6887) corrected to 1265-1389 Cal AD (Stuiver & Pearson 1986). This and the Ipswich evidence suggests that syphilis may have been present in Europe prior to Columbus' contact with the New World.

***(f) Osteoporosis***

In modern Western populations bone mass tends to decrease after the 4th decade; the point at which loss of bone mineral is classified as osteoporosis is arbitrary (Kelsey 1987). In the Blackfriars assemblage 9 skeletons (burials 1738, 1795, 1925, 1932, 1965, 2320, 2537, 2548 and 2628) had noticeably light, radiolucent bones with thin cortices and were thus classified as osteoporotic.

Osteoporosis weakens the bones and hence predisposes to fractures. Of the 9 individuals showing osteoporosis, 4 show one or more healed fractures. For many of these fractures it is impossible to determine whether osteoporosis was a predisposing factor or whether the individual sustained the fracture before he or she suffered from osteoporosis. A rib fracture in 1965 and the fracture of the sternal body in 2548 are united by cancellous bone and would appear to have been sustained not long before death and so could have been precipitated by osteoporosis. Compression fractures of the vertebral bodies are common in sufferers from osteoporosis (Kelsey 1987; Mensforth & Latimer 1989), hence it may be that those sustained by 1965 and 2537 were precipitated by osteoporosis.

Brief mention should be made here of a condition in which there is bilateral thinning of the parietal bones. This condition generally occurs in the elderly and may be associated with senile osteoporosis (Lodge 1967). Two individuals show biparietal thinning: 0962 (female aged 50+) and 1738 (female aged 50+), the latter also shows osteoporosis.

In modern, Western groups osteoporosis is primarily a disease affecting middle aged and elderly women, and consistent with this all but 2 of the 9 skeletons classified as osteoporotic were middle aged or elderly females, the exceptions being 1932, a probable female aged 25-35, and 2548, a probable male aged 25-35. It has been shown (Donaldson et al. 1970) that prolonged immobility may result in significant loss of bone mineral; thus if an individual was bedridden for an extended period prior to death one might expect an osteoporotic skeleton - perhaps this might have been a causative factor in these two cases.
In the 10th-11th century School Street assemblage no cases of osteoporosis were identified among the 79 adults. The difference between this and the 13th-16th century material is probably associated with the greater adult age at death in the latter, but it also suggests that in no case was an Anglo-Saxon adult bedridden for a sufficient period immediately prior to death for osteoporotic changes to occur in the skeleton.

***(g) Neoplasms***
Five individuals show evidence for neoplasms; 4 of these (1068 (male aged 35-45), 1982 (female aged 25-35), 2556 (female aged about 25) and 2628 (female aged 50+)) show button osteomata on the outer table of the skull. A button osteoma is a benign bone tumour; it presents in dry bones as a small, smooth, approximately circular projection, most frequently on the outer table of the frontal or parietal bones, or in the sinuses (Steinbock 1976: 328f; Ortner & Putschar 1985:

368f).  In all the present cases the osteoma is solitary, all are located on the outer tables of frontal or parietal bones, and sizes range from 6-12mm diameter.

Burial 0954 (male aged 25-35) displays a 10x9mm area of bone raised 2mm proud of the normal bone surface on the right maxilla between the infra-orbital foramen and the pyriform aperture. The surface of this lesion has partly broken away post-mortem, revealing a cavity with spicular bone within it.  This lesion is probably indicative of a neoplasm.

***(h) Miscellaneous disease***
Burial 0950 (male aged 60+).  The left humerus, right femur, distal half of the left femur, right tibia, proximal half of the left tibia, right talus and calcaneus, the 4th lumbar vertebra, sacrum and pelvic bones are irregularly swollen and deformed.  The right femoral head is rather flattened and there is some lateral bowing of the shaft; the left tibia shows anterior bowing, the right is too fragmentary to assess.  X-ray reveals sharp demarcation between the normal and pathological bone in the left femur and tibia, and all affected bones show patchy rarification and increased cortical thickness (Plates 36 & 37).  These lesions are typical of Paget's disease.

Paget's disease is a distortion of the normal bone remodelling mechanism in which there is initially excessive bone resorbtion, followed by excessive, disorganised new bone deposition. The architecture of the new bone is abnormal.  The aetiology of the disorder is unclear, although it may be a slow viral infection (Hamdy 1981).  It is a disease of the middle aged and elderly - it seldom appears before the age of 40 (ibid.).

Although Pagetic bones are thicker than normal, they are also weaker and pathological fractures are a frequent complication of the disease.  In 0950 3 pathological (and no normal) bones show fractures.  There is a compression fracture of the 4th lumbar vertebral body, a united oblique fracture of the left humerus, just above the olecranon fossa, and the right femur shows an un-united transverse sub-trochanteric fracture (Plate 38).  The surfaces of the femoral fracture show varying degrees of remodelling, in some places the bone is smooth, in others trabeculae, although remodelled, are clearly visible.  Comparison with modern specimens (Barber 1929) suggests that this fracture occurred a few weeks prior to death (although the possibility that fractures in Pagetic bones heal at a different rate to those in normal bone should not be forgotten - Dove 1980).

Osteoarthritis is also a common complication of Paget's disease, probably because the deformed bones result in un-natural stresses upon the joints (Hamdy 1981).  Burial 0950 shows severe and widespread osteoarthritis, especially at the vertebral facet joints and shoulders (Plate 39).
It is worth noting here that the distal end of the shaft of the left femur of 2591 (male aged 35-45) is somewhat swollen with a slightly roughened surface and the cortex here is replaced by cancellous bone exhibiting a sparse trabecular structure; the demarcation between normal and pathological bone is sharp and distinct.  In addition X-ray suggests that there is coarsening of the

trabeculae on the the left ilium in the area of the sacro-iliac articulation. The appearance of these lesions is very similar to those in 0950 although the radiological changes are insufficient to sustain a diagnosis of Paget's disease (Guyer pers comm).

Pagetic bone mineral is histologically abnormal (Hamdy 1981: 35-36), hence, with a view to aiding diagnosis, attempts were made to prepare histological sections from the abnormal bone of burials 0950 and 2591. However, despite considerable efforts it proved impossible to produce adequate sections from these specimens.

Burial 1455 (male aged about 18). There is a marked lateral asymmetry in the mid-thoracic vertebrae, the height being reduced on the left sides of their centra, the left facet joints are reduced in size and the left transverse processes are more slender than their counterparts on the right side. The facet joints on the cervical vertebrae show a similar asymmetry but the bodies are normal. The lumbar vertebrae are slightly damaged post-mortem but show no great asymmetry. These changes result in 90-100 degree scoliosis of the thoracic spine (Plate 40); there is no scoliosis in the cervical or lumbar spines. At the apex of the curve the 5th and 6th thoracic vertebrae are fused at their left facet joints (Plate 41). The ribs show asymmetrical development in response to the scoliosis, with those on the convex side of the curve (the right ribs) showing increased curvature; those on the concave side are slender and show reduced curvature. The facet joints of those vertebrae near the apex of the curve show grade 2 osteoarthritis, a testimony to the additional stresses imposed upon them by the spinal deformity.

The frontal bone of burial 1477 (unsexed adult) is thickened and has a knobbly, irregular internal surface. This type of internal frontal hyperostosis is most frequent in older females where it is thought to be associated with elevated androgen levels (refs in Armelagos & Chrisman 1988). According to Revel (1986: 174) it is almost never seen in males. Burial 1477 is very poorly preserved and incomplete and not even a tentative determination of sex could be made.

## 6. Summary

Two hundred and fifty burials from within the Ipswich Blackfriars complex were examined; they date from the period 1263-1538 and represent interments of layfolk and friars.

Bone preservation is variable and some bones exhibit staining which may be associated with fungal activity during burial. Many of the graves were cut by other features, principally later graves; this, together with destruction of bones by physical and chemical factors in the soil, is a major factor affecting the completeness of the skeletons from the site. Despite the above the Blackfriars site skeletons are generally more complete than those excavated from the 10th-11th century cemetery also located on the School Street site.

A study of the representation of the different skeletal elements was carried out in order to investigate the effects of recovery and preservation factors on different parts of the skeleton. As might be expected the denser, larger bones were least vulnerable to destruction by soil erosion. Representation of the small bones of the extremities was affected both by preservation and recovery factors.

In common with burials from other friary sites there is under-representation of juveniles, and males outnumber females. This last was true for all areas of the friary yielding sexable skeletons and it would seem logical to argue that this is due to the burials of friars increasing the numbers of males. Females were found in all locations save the chapter house and the south range of the cloister (although only a few burials from these locations were studied), indicating that layfolk were interred in all locations, except possibly these. There was no spatial patterning in the interments of males and females in any location. The above data suggest that burials of friars were not in general segregated from those of lay benefactors, except, perhaps in the chapter house and the south range of the cloister. There are only 5 infants in the assemblage and all were buried in the choir. The age at death of adults was rather greater than that in the assemblage from the 10th-11th century cemetery at the School Street site.

An association was found between arm position in the burials and gender; this was largely due to those interments buried with their arms placed across the chest area being predominantly males - indeed no certain females were interred in this posture.

Taken in conjunction with other sites in the region, the craniometric data suggest that brachycephaly was the norm in the Mediaeval period in East Anglia in contrast to the predominance of dolichocephaly in the Saxon period. This pattern has also been found for York and it has been suggested that it may be general. The reasons for this change in cranial form around the time of the Norman conquest are obscure, but it should be noted that secular changes in cranial form do not necessarily imply the arrival of immigrants (Kouchi 1986).

Stature is similar to that for other Mediaeval groups and to modern British figures. It is also similar to that for the 10th-11th century School Street people, although post-cranial measurements confirmed the impression that the 13th-16th century Blackfriars people were of rather more robust build than their 10th-11th century forebears. A study of directional asymmetry in the appendicular skeleton was also carried out. This showed that for the arm bone dimensions studied, mean measurements for right arm bones were significantly greater than those for the left side, whereas for the leg bone measurements, with the exception of the femoral head diameter, there was no significant difference. The directional asymmetry observed in the arm bones is probably associated with handedness, assuming a preponderance of right-handers in the assemblage. Why directional asymmetry was observed in femoral head diameter, but no other leg bone measurements is difficult to explain.

The non-metric traits show no evidence for burial together of genetically related individuals in "family groups" (in contrast with the 10th-11th century School Street cemetery in which such "family groups" were tentatively identified). The number of non-metric variants having a different frequency in males and females is greater than expected by chance; it was felt that the most probable explanation for this was that it reflects a difference in genetic composition of the male and female parts of the assemblage, connected with the probability that the latter is drawn from the population of local layfolk, whereas the former are a mixture of layfolk and friars.

The pathologies evident upon the skeleton at time of death are, to a great extent a cumulative record of insults suffered during life. Furthermore in most cases it is only the more chronic conditions which manifest themselves upon the bones, and many bone diseases are diseases of old age. Although the age correlation is greater for some conditions than for others, these factors mean that the prevalence of most bony pathologies will tend to be greater in assemblages with a greater adult age at death. The Blackfriars adults show a greater number and variety of pathological conditions than do the Anglo-Saxon School Street skeletons; although by no means the full explanation, the greater age at death of the former is an important factor here.

The prevalence of dental pathologies is similar to those for other Mediaeval assemblages and comparison with the 10th-11th century assemblage offers no evidence for dietary differences between the 2 groups.
The greater frequency of osteoarthritis and vertebral osteophytosis in the Blackfriars assemblage is, at least in part, a function of their greater age at death; the distribution of lesions in the skeleton is similar to that in the Anglo-Saxon burials which, taking into account the aetiology of the conditions, could be interpreted as suggesting a similar pattern of stress to the joints, providing no evidence for any marked differences in activity patterns between the 2 groups.

The evidence for juvenile health status suggests a fairly healthy childhood for those chosen for burial at the friary, with any episodes of disease or poor nutrition mainly being of a fairly trivial and transient nature.

A notable finding is the high level of diffuse idiopathic skeletal hyperostosis (DISH). When the effect of age at death is controlled for, the frequency of the condition is markedly higher than in contemporary populations and in the Anglo-Saxon School Street assemblage (where there is no evidence for it at all). In modern populations increased frequencies of DISH have beenassociated with obesity. Although one would not wish to overstretch the evidence, perhaps the high frequency of DISH in the Ipswich Blackfriars assemblage suggests obesity may have been a problem among the friars and wealthy benefactors buried at the friary.

Documentary evidence suggests that chronic non-specific infections of the lower legs were common in Post-Mediaeval times, particularly among the lower social classes, and it may be that their chronic nature was due to deficiency of ascorbic acid caused by lack of fresh fruit and vegetables in the diet. At Ipswich the evidence is that infection of the lower legs was fairly common but that the infections were not long-lasting, implying a sufficiently well-balanced diet to enable speedy recovery.

It seems probable that the Blackfriars burials are from the wealthier strata of the population; the above three observations might be viewed as suggesting that this group were also privileged in terms of diet and general health.

Six probable cases of erosive arthropathies are described, including possible cases of gout and rheumatoid arthritis. This last is of interest because few archaeological specimens show changes consistent with this disease and some writers assert that it is an entirely modern disorder.

Several individuals showed evidence for hallux valgus, caused by footwear which constricts the toes. This finding is consistent with Mediaeval artistic depictions of individuals wearing pointed shoes, and with archaeological finds of footwear which must have constricted the toes. Most of the individuals showing hallux valgus were males, suggesting that in this group it was mainly men who wore constricting footwear. Hallux valgus was not found in the 10th-11th century material suggesting that, unlike their 13th-16th century counterparts they did not habitually wear shoes which constricted the toes.

The greater skeletal completeness and greater age at death are undoubtedly responsible, at least in part, for the greater frequency of fractures in the Blackfriars burials than in their 10th-11th century predecessors. Three individuals show evidence for cranial injuries from edged weapons and in one case the injuries were very probably cause of death (the only case out of the 250 individuals in which cause of death can be inferred). Three other individuals show injuries which are probably a result of inter-personal violence (including one unusual case in which the tip of an iron projectile, weapon or implement is embedded in the skull), and in addition there was one individual with an amputated hand, a mutilation which may have resulted from inter-personal violence rather than surgical intervention. All individuals showing weapon injuries are males (as is generally the case), as are all those showing injuries probably due to inter-personal violence, with the exception of one female showing a midshaft ulna fracture; although such injuries are frequently a result of the raising of the forearm to parry a blow it is also possible that its cause was accident rather than violence. A notable difference between the present group and the Anglo-Saxon School Street burials is the absence of any weapon injuries among the latter - they only showed one fracture which was more probably a result of violence rather than accident, an ulna "parry fracture". Documentary evidence indicates a high frequency of deaths through violence among sections of the Mediaeval peerage and it also suggests a great deal of lawlessness in Suffolk at times during the period at which the friary was in existence. This is not reflected in the Ipswich skeletal data - there is only one instance of violent death evident from the remains and, despite the above, most fractures are of a type more often associated with accident than violence.

Although there are a few cases of non-union, most fractures seemed to have healed firmly with little shortening or deformity, although this does not necessarily imply treatment via splinting etc.

That leprosy was present in Ipswich in Saxon times is demonstrated by the recovery of a leprous skeleton from the Anglo-Saxon School Street cemetery. Four leprous individuals were identified in the Blackfriars assemblage. During the Mediaeval period considerable efforts were made to segregate sufferers from this disease by their isolation in leper hospitals, in whose cemeteries they were normally buried. All 4 cases showed changes to the facial bones indicating that the characteristic facial stigmata of the disease would have been evident in life. One individual is female indicating that at least one of the four was a lay benefactor rather than a friar. It may be that these sufferers were cared for by their families - particularly as it seems probable that that the Blackfriars burials are from the wealthier strata of the population; the wealthy would have been in a better position to care for afflicted relatives and prevent them being isolated in leprosaria against their will. Alternatively relatives of leper hospital inmates may have ensured the return of their bodies to the friary for burial. In this light the existence of skeletal evidence for a familial relationship between a leprous and a non-leprous skeleton is of interest.

A case of syphilis is tentatively identified. Since it has frequently been asserted that this disease was brought back from the New World by Columbus and his crew it was thought to be of interest to determine the date of this skeleton using a high-precision radiocarbon method. This indicated that there is about an 84% chance that the specimen pre-dates Columbus' return to Europe in 1493, casting doubt on the Columbian hypothesis for the origin of syphilis.

Unlike the 10th-11th century material there was evidence for osteoporosis in some of the Blackfriars skeletons. This is consistent with the greater age at death of the adults in the Mediaeval assemblage - most cases identified here are middle aged or elderly females. It was also identified in 2 adults who seemed to be aged under 35. A possible explanation for this finding is that these individuals were bed-ridden for a prolonged period prior to death - prolonged inactivity is a cause of bone mineral loss.

Possible cases of tuberculosis and Paget's disease are also present.

## 7. References

Anderson, S.M. (1990). The Human Remains From Staunch Meadow, Brandon, Suffolk. AM Lab Report 99/90.

Anderson, S.M. (1991). The Human Skeletal Remains From Caister on Sea, Norfolk. AM Lab Report 9/91.

Anderson, S.M. & Birkett, D.B. (1989). The Human Skeletal Remains From Burgh Castle,

Norfolk, 1960. AM Lab Report 27/89.
Armelagos, G.J. & Chrisman, O.D. (1988). Hyperostosis Frontalis Interna: A Nubian Case. American Journal of Physical Anthropology 76: 25-28.
Baker, B.J. & Armelagos, G.J. (1988). The Origin and Antiquity of Syphilis. Current Anthropology 29: 703-737.
Barber, C.G. (1929). Immediate and Eventual Features of Healing in Amputated Bones. Annals of Surgery 90: 985-992.
Barber, C.G. (1930). The Detailed Changes Characteristic of Healing Bone in Amputation Stumps. Journal of Bone & Joint Surgery 12: 353-359.
Barnett, C.H. (1962). The Normal Orientation of the Human Hallux and the Effect of Footwear. Journal of Anatomy 96: 489-494.
Bayley, J. (1975). Chelmsford Dominican Priory Human Bone Report. AM Lab Report 1890.
Bedbrook, G. (1982). Injuries to the Hip. In (Wilson, J.N., ed) Watson-Jones Fractures & Joint Injuries (6th edition). Churchill-Livingstone, London. pp. 878-973.
Benjamin, A. (1982). Injuries of the Forearm. In (Wilson, J.N., ed) Watson-Jones Fractures and Joint Injuries. Churchill- Livingstone, London. pp. 650-709.
Berry, A.C. (1975). Factors Affecting the Incidence of Non- metric Skeletal Variants. Journal of Anatomy 120: 519-535.
Berry, A.C. & Berry, R.J. (1967). Epigenetic Variation in the Human Cranium. Journal of Anatomy 101: 361-379.
Birkett, D. A. (1986). The Human Burials. In (Daniels, R.) The Excavation of the Church of the Franciscans, Hartlepool, Cleveland. Archaeological Journal 143: 291-299.
Blatchly, J. & Wade, K. (1980). Excavations at Ipswich Blackfriars. Proceedings of the Suffolk Archaeological and Historical Society 34: 25-34.
Brigode, M., Francois, R.J. & Dory, M.A. (1982). Radiological Study of the Sacroiliac Joints in Vertebral Ankylosing Hyperostosis. Annals of the Rheumatic Diseases 41: 225-231.
Brook, A.H. (1984). A Unifying Aetiological Explanation for Anomalies of Human Tooth Number and Size. Archives of Oral Biology 29: 373-378.
Brothwell, D.R. (1959). Teeth in earlier Human Populations. Proceedings of the Nutrition Society 18: 59-65.
Brothwell, D.R. (1961). The Palaeopathology of Early British Man: An Essay on the Problems of Diagnosis and Analysis. Journal of the Royal Anthropological Institute 91: 318-344.
Brothwell, D.R. (1963). Digging Up Bones (1st edition). Oxford University Press (British Museum Natural History), Oxford.
Brothwell, D.R. (1970). The Real History of Syphilis. Science Journal 6 (9): 27-33.
Brothwell, D.R. (1972). Digging Up Bones (2nd edition). Oxford University Press (British Museum Natural History), Oxford.
Brothwell, D.R. (1981). Digging Up Bones (3rd edition). Oxford University Press (British Museum Natural History), Oxford.
Brothwell, D.R. (1987). The Problem of the Interpretation of Child Mortality In Earlier Populations. Antropologia Portuguesa 5: 135-143.

Buikstra, J.E. & Mielke, J.H. (1985). Demography, Diet and Health. In (Gilbert, R.I. & Mielke, J.H., eds) The Analysis of Prehistoric Diets. Academic Press, London. pp. 359-422.
Cayton, H. (1980). Some Contributions From Written Sources. In (Wade-Martins, P.) Excavations in North Elmham Park 1967-1972. East Anglian Archaeology Report No. 9. pp. 302-313.
Chhabriya, B.D., Sharma, N.C., Bansal, N.K. & Agrawal, G.R. (1985). Bone Changes in Leprosy: A Study of 50 Cases. Indian Journal of Leprosy 57: 632-641.
Clay, R.M. (1909). The Mediaeval Hospitals of England. Methuen, London.
Costa R.L. (1982). Periodontal Disease at the Prehistoric Ipiutak and Tigara Skeletal Remains From Point Hope, Alaska. American Journal of Physical Anthropology 59: 97-110.
Dawes, J.D. (1980). The Human Bones. In (Dawes, J.D. & Magilton, J.R.) The Cemetery of St Helen-on-the-Walls, Aldwark. The Archaeology of York: The Mediaeval Cemeteries Vol 12/1. York Archaeological Trust. pp. 19-120.
Dawes, J.D. (1987). The Human Bones. In (Armstrong, P. & Tomlinson, D., eds) Excavations at the Dominican Priory, Beverley 1960-83. Humberside County Council, Hull. pp. 26-29.
Dieppe, P. (1989). The History of Rheumatoid Arthritis. In (Maddison, P.J., ed) The Antiquity of the Erosive Arthropathies. The Arthritis and Rheumatism Council for Research Conference Proceedings No. 5. pp. 35-38.
Dobney, K. & Brothwell, D. (1987). A Method For Evaluating the Amount of Dental Calculus on Teeth From Archaeological Sites. Journal of Archaeological Science 14: 343-351.
Donaldson, C.L., Hulley, S.B., Vogel, J.M., Hatter, R.S., Buyers, J.H. & McMillar, D.E. (1970). Effect of Prolonged Bed Rest on Bone Mineral. Metabolism, Clinical & Experimental 19: 1071- 1084.
Dove, J. (1980). Complete Fractures of the Femur in Paget's Disease of Bone. Journal of Bone & Joint Surgery 62B: 12-17.
van Dusen, C.R. (1939). An Anthropological Study of the Upper Extremeties of Children. Human Biology 11: 277-284.
Eisenstein, S. (1978). Spondylolysis: A Skeletal Investigation of Two Population Groups. Journal of Bone & Joint Surgery 60B: 488-494.
Falk, D., Pyne, L., Helmkamp, R.C. & De Rousseau, C.J. (1988). Directional Asymmetry in the Forelimb of Macaca mulatta. American Journal of Physical Anthropology 77: 1-6.
Finnegan, M. (1978). Non-metric Variation in the Infra-cranial Skeleton. Journal of Anatomy 125: 23-37
Gilyard-Beer, R. (1980). Ipswich Blackfriars. Proceedings of the Suffolk Archaeological & Historical Society 34: 15-23.
Golding, B. (1986). Burials and Benefactors: An Aspect of Monastic Patronage in Thirteenth Century England. In (Ormrod, W.M., ed) England in the Thirteenth Century. Proceedings of the Harlaxton Conference. Boydell, Dover. pp. 64-75.
Gondos, M. (1972). The Pointed Tubular Bone: Its Significance and Pathogenesis. Radiology

105: 541-545.
Goodman, A.H. & Armelagos, G.J. (1988). Childhood Stress and Decreased Longevity in a Prehistoric Population. American Anthropologist 90: 936-944.
Goodman, A.H., Armelagos, G.J. & Rose, J.C. (1980). Enamel Hypoplasias as Indicators of Stress in Three Prehistoric Populations From Illinois. Human Biology 52: 515-528.
Gordon, C.G. & Buikstra, J.E. (1981). Soil pH, Bone Preservation and Sampling Bias at Mortuary Sites. American Antiquity 46: 566-571.
Graber, L.W. (1978). Congenital Absence of Teeth: a Review With Emphasis on Inheritance Patterns. Journal of the American Dental Association 96: 266-275.
Grahnen, H. (1956). Hypodontia in the Permanent Dentition; A Clinical and Genetical Investigation. Odontologisk Revy 7 Supplement 3.
Griffiths, I.D. (1986). Osteonecrosis. In (Scott, J., ed) Copeman's Textbook of the Rheumatic Diseases (6th edition). Churchill-Livingstone, London. pp. 1207-1228.
Griffiths, R. (1978). The Human Skeletal Remains. In (Williams, J.H.) Excavations at Greyfriars, Northampton, 1972. Northampton Archaeology 13: 155-157.
Hackett, C.J. (1983). Problems in the Palaeopathology of the Human Treponematoses. In (Hart, G.D., ed) Disease in Ancient Man. Clarke Irwin, Toronto. pp. 106-128.
Hamdy, R.C. (1981). Paget's Disease of Bone. Armour Pharmaceuticals, Eastbourne
Harman, M. (1985). The Human Remains. In (Lambrick, G.) Further Excavations at the Second Site of the Dominican Priory, Oxford. Oxoniensa 50: 188-190.
Henderson, J. (1984a). The Human Remains. In (Poulton, R. & Woods, H.) Excavations on the Site of the Dominican Friary at Guildford in 1974 and 1978. Research Volume of the Surrey Archaeological Society Vol. 9. pp. 58-71.
Henderson, J. (1984b). The Human Bones From Blackfriars Street, Carlisle. AM Lab Report 4350.
Hengen, O.P. (1971). Cribra Orbitalia: Pathogenesis and Probable Aetiology. HOMO 22: 57-76.
Hinnebusch, W.A. (1951). The Early English Friars Preachers. Institutum Historicum, Rome.
Hollingsworth, T.H. (1975). A Note on the Mediaeval Longevity of the Secular Peerage 1350-1500. Population Studies 29: 155-159.
Howells, W.W. (1973). Cranial Variation in Man: A Study by Multivariate Analysis of Patterns of Difference Among Recent Human Populations. Papers of the Peabody Museum of Archaeology & Ethnography No 67.
Jacobs, P. (1976). Osteochondrosis (osteochondritis). In (Davidson, J.K., ed) Aseptic Necrosis of Bone. Excerpta Medica, Oxford. pp. 301-332.
Jensen, P.S. & Steinbach, H.L. (1977). Roentgen Features of the Rheumatic Diseases. The Medical Clinics of North America 61: 389-404.
Julkunen, H., Heinonen, O.P. & Pyo"ra"la", K. (1971). Hyperostosis of the Spine in an Adult Population. Annals of the Rheumatic Diseases 30: 605-612.
Kellgren, J.H. (1961). Osteoarthrosis in Patients and Populations. British Medical Journal 2: 1-6.

Kellgren, J.H. & Lawrence, J.S. (1958). Osteo-Arthrosis and Disc Degeneration in an Urban Population. Annals of the Rheumatic Diseases 17: 388-397.
Kelsey, J.L. (1987). Epidemiology of Osteoporosis & Associated Fractures. Bone & Mineral Research 5: 409-444.
King, A.J. & Catterall, R.D. (1959). Syphilis of Bones. British Journal of the Venereal Diseases 35: 116-127.
Kouchi, M. (1986). Geographic Variations in Modern Japanese Somatometric Data: A Secular Change Hypothesis. In (Akazawa, T. & Aikens, C.M., eds) Prehistoric Hunter-Gatherers in Japan. New Research Methods. The University Museum, University of Tokyo Bulletin No 27.
Lechat, M.F. (1962). Bone Lesions in Leprosy. International Journal of Leprosy 30: 125-137.
Loader, T. (n.d.) The Burials at Ipswich Blackfriars. Unpublished Manuscript.
Lodge, T. (1967). Thinning of the Parietal Bones in Early Egyptian Populations and its Aetiology in the Light of Modern Observations. In (Brothwell, D.R. & Sandison, A.T., eds) Diseases in Antiquity. Charles C. Thomas, Springfield. pp. 405-412.
Loudon, I.S.L. (1981). Leg Ulcers in the 18th and Early 19th Centuries. Journal of the Royal College of General Practitioners 31: 263-273.
Lovejoy, C.O. & Heiple, K.G. (1981). The Analysis of Fractures in Skeletal Populations With an Example From the Libben Site, Ottawa County, Ohio. American Journal of Physical Anthropology 55: 529-541.
Lovejoy, C.O., Burstein, A.H. & Heiple, K.G. (1976). The Biomechanical Analysis of Bone Strength: A Method and its Application to Platycnemia. American Journal of Physical Anthropology 44: 489-506.
McCarty, D.J. (1989). Clinical Picture of Rheumatoid Arthritis. In (McCarty, D.J., ed) Arthritis & Allied Conditions: A Textbook of Rheumatology (11th edition). Lea & Febiger, Philadelphia. pp. 715-742.
Manchester, K. (1980). Hydrocephalus in an Anglo-Saxon Child From Eccles. Archaeologia Cantiana 96: 77-82.
Manchester, K. (1983). The Archaeology of Disease. University of Bradford Press, Bradford.
Manchester, K. & Roberts, C. (1989). The Palaeopathology of Leprosy in Britain: A Review. World Archaeology 21: 265-272.
Maresh, M.M. (1955). Linear Growth of Long Bones of Extremeties From Infancy Through Adolescence. American Journal of the Diseases of Children 89: 725-742.
Martel, W. (1968). The Overhanging Margin of Bone: A Roentgenological Manifestation of Gout. Radiology 91: 755-756.
Martin, W.J., Underdahl, L.O., Mathieson, D.R. & Pugh, D.G. (1955). Alkaptonuria, A Report of 12 Cases. Annals of Internal Medicine 42: 1052-1064.
Mays, S.A. (1985). The Relationship Between Harris Line Formation & Bone Growth & Development. Journal of Archaeological Science 12: 207-220.
Mays, S.A. (1987). Social Organisation & Social Change in the Early & Middle Bronze Age of

Central Europe. A Study Using Human Skeletal Remains. PhD Thesis, University of Southampton.

Mays, S.A. (1989). The Anglo-Saxon Human Bone From School Street, Ipswich, Suffolk. AM Lab Report 115/89.

Mays, S.A. (1991). The Burials From the Whitefriars Friary Site, Buttermarket, Ipswich, Suffolk (Excavated 1986-88). AM Lab Report /91.

Meindl, R.S., Lovejoy, C.O., Mensforth, R.P. & Don Carlos, L. (1985). Accuracy & Direction of Error in the Sexing of the Skeleton: Implications for Palaeodemography. American Journal of Physical Anthropology 68: 79-85.

Mensforth, R.P., Lovejoy, C.O., Lallo, J.W. & Armelagos, G.J. (1978). The Role of Constitutional Factors, Diet & Infectious Disease in the Aetiology of Porotic Hyperostosis & Periosteal Reactions in Prehistoric Infants & Children. Medical Anthropology 2(1): 1-59.

Mensforth, R.P. & Latimer, B.M. (1989). Hamann-Todd Collection Ageing Studies: Osteoporosis Fracture Syndrome. American Journal of Physical Anthropology 80: 461-479.

Miles, A.E.W. (1963). The Dentition in the Assessment of Individual Age in Skeletal Material. In (Brothwell, D.R., ed) Dental Anthropology. Pergamon, London. pp. 191-209.
Mo/ller-Christensen, V. (1961). Bone Changes in Leprosy. John Wright, Bristol.

Mo/ller-Christensen, V. (1974). Changes in the Anterior Nasal Spine & the Alveolar Process of the Maxillae in Leprosy. A Clinical Examination. International Journal of Leprosy 42: 431-435.

Moore, W.J. & Corbett, M.E. (1978). Dental Caries Experience in Man. In (Rowe, N.H., ed) Diet, Nutrition & Dental Caries. University of Michigan School of Dentistry & the Dental Research Institute, Michigan. pp. 3-19.

Moore, W.J. & Corbett, M.E. (1983). Dental & Alveolar Infection. In (Hart, G.D., ed) Diseases in Ancient Man. Clarke-Irwin, Toronto. pp. 139-155.
Mörmann, S.E. & Mühlemann, H.R. (1981). Oral Starch Degradation & its Influence on Acid Production in Human Dental Plaque. Caries Research 15: 166-175.

O'Brien, W.M., La Du, B.N. & Bunim, J.J. (1963). Biochemical, Pathologic & Clinical Aspects of Alkaptonuria, Ochronosis & Ochronotic Arthropathy. American Journal of Medicine 34: 813- 838.

O'Connor, T.P. (1984). A Report on the Human Remains From Rivenhall Church, Essex. AM Lab Report 4357.

Ortner, D.J. & Putschar, W.G.J. (1985). Identification of Pathological Conditions in Human Skeletal Remains. Reprint Edition of Smithsonian Contributions to Anthropology No. 28. Smithsonian Institute Press, Washington.

Ossenburg, N. S. (1977). Within & Between Race Distances in Population Studies Based on Discrete Traits of the Human Skull. American Journal of Physical Anthropology 45: 701-716.

Page, W. (1975). The Victoria History of the Counties of England: Suffolk. Volume 2.

University of London Institute of Historical research, London.
Palmer, C.F.R. (1887). The Friar-Preachers, or Blackfriars, of Ipswich. The Reliquary 1 (ns): 24-29.
Palmer, C.F.R. (1891). Burials at the Priories of the Black Friars. The Antiquary 23: 122-126 & 24: 28-30, 76-79, 117-120, 265-269.
Patterson, D.E. (1961). Bone Changes in Leprosy. Their Incidence, Progress, Prevention & Arrest. International Journal of Leprosy 29: 393-422.
Perizonius, W.R.K. (1984). Closing & Non-Closing Sutures in 256 Crania of Known Age & Sex From Amsterdam (AD 1883-1909). Journal of Human Evolution 13: 201-206.
Pettersson, H. (1980). Bilateral Dysplasia of the Neck of the Scapula and Associated Anomalies. Acta Radiologica Diagnosis 22: 81-84.
Piepenbrink, H. (1986). Two Examples of Biogenous Dead Bone Decomposition & Their Consequences for Taphonomic Interpretation. Journal of Archaeological Science 13: 417-430.
Pindborg, J.J. (1970). The Pathology of the Dental Hard Tissues. Munksgaard, Copenhagen.
Poulton, R. & Woods, H. (1984). Excavations on the Site of the Dominican Friary at Guildford in 1974 & 1978. Research Volume of the Surrey Archaeological Society No. 9.
Radin, E.L., Paul, I.L. & Rose, R.M. (1980). Osteoarthrosis as a Final Common Pathway. In (Nuki, G., ed) The Aetiopathogenesis of Osteoarthrosis. Pitman Medical, London. pp. 84-89.
Resnick, D. (1985). Degenerative Diseases of the Vertebral Column. Radiology 156: 3-14.
Resnick, D. & Niwayama, G. (1988). Diagnosis of Bone & Joint Disorders (2nd edition). W.B. Saunders, London.
Revell, P. (1986). Pathology of Bone. Springer, Berlin.
Rogers, J., Waldron, T., Dieppe, P. & Watt, I. (1987). Arthropathies in Palaeopathology: The Basis of Classification According to Most Probable Cause. Journal of Archaeological Science 14: 179-183.
Rogers,J. (1989). Case Histories. In (Maddison, P.J., ed) The Antiquity of the Erosive Arthropathies. Arthritis & Rheumatism Council for Research Conference Proceedings No 5. pp. 45-47.
Rose, J.C., Armelagos, G.J. & Lallo, J.W. (1978). Histological Enamel Indicators of Childhood Stress in Prehistoric Skeletal Samples. American Journal of Physical Anthropology 49; 511- 516.
Russell, J.C. (1937). Length of Life in England, 1250-1348. Human Biology 9: 528-541.
Sarnat, B.G. & Schour, I. (1941). Enamel Hypoplasia (Chronologic Enamel Aplasia) in Relation to Systemic Disease: Chronologic, Morphologic & Etiologic Classification. Journal of the American Dental Association 28: 1989-2000.
Schell, L.M., Johnson, F.E., Smith, D.R. & Paoline, A.M. (1985). Directional Asymmetry of Body Dimensions Among White Adolescents. American Journal of Physical Anthropology 67: 317-322.
Scheuer, J.H., Musgrave, J.H. & Evans, S.P. (1980). The Estimation of Late Foetal and

Perinatal Age From Limb Bone Length by Linear and Logarithmic Regression. Annals of Human Biology 7: 257-265.
Schmorl, G. & Junghanns, H. (1971). The Human Spine in Health & Disease (2nd American edition, translated by E.F. Beseman). Grune & Stratton, New York.
Schulter-Ellis, F.P. (1980). Evidence of Handedness on Documented Skeletons. Journal of Forensic Science 25: 624-630.
Schultz, A.H. (1926). Foetal Growth of Man and Other Primates. Quartely Review of Biology 1: 465-521.
Schultz, A.H. (1967). Notes on Diseases and Healed Fractures of Wild Apes. In (Brothwell, D.R. & Sandison, A.T., eds) Diseases in Antiquity. Charles C. Thomas, Springfield. pp. 47-55.
Schumacher, H.R. (1989). Ochronosis, Haemochromatosis and Wilson's Disease. In (McCarty, D.J., ed) Arthritis & Allied Conditions. A Textbook of Rheumatology (11th edition). Lea & Febiger, Philadelphia. pp. 1798-1806.
Shafer, W.G., Hine, M.K. & Levy, B.M. (1983). A Textbook of Oral Pathology (4th edition). W.B. Saunders, Philadelphia.
Sjøvold, T. (1984). A Report on the Heritability of Some Cranial Measurements and Non-Metric Traits. In (van Vark, G.N. & Howells, W.W., eds) Multivariate Statistical Methods in Physical Anthropology. D. Riedel, Groningen. pp. 223-246.
Steane, J.M. (1985). The Archaeology of Mediaeval England and Wales. Croom Helm, London.
Steinbock, R.T. (1976). Palaeopathological Diagnosis and Interpretation. Charles C. Thomas, Springfield.
Stinson, S. (1985). Sex Differences in Environmental Sensitivity During Growth and Development. Yearbook of Physical Anthropology 28: 123-147.
Stirland, A. (1981). The Human Bones. In (Mellor, J.E. & Pearce, T., eds) The Austin Friars, Leicester. CBA Research Report 35. CBA, London. p. 168.
Stirland, A. (1985). The Human Bones. In (Ayers, B.) Excavations Within the North-East Bailey of Norwich Castle, 1979. East Anglian Archaeology No. 28. pp. 49-57.
Stuart-Macadam, P. (1989). Porotic Hyperostosis: Relationship Between Orbital & Vault Lesions. American Journal of Physical Anthropology 80: 187-193.
Stuiver, M. & Pearson, G.W. (1986). High Precision Calibration of the Radiocarbon Time Scale AD 1950-500 BC. Radiocarbon 28: 805-838.
Suchey, J.M., Wisely, D.V. & Katz, D. (1987). Evaluation of the Todd & McKern-Stewart Methods of Ageing the Male Os pubis. In (Reichs, K.J., ed) Forensic Osteology: Advances in the Identification of Human Remains. Charles, C. Thomas, Springfield. pp. 33-67.
Suchey, J.M., Brooks, S.T. & Katz, D. (1988). Instructions For the Use of the Suchey-Brooks System for Age Determination of the Female Os Pubis. Instructions materials accompanying female pubic symphyseal models of the Suchey-Brooks System. Distributed by France Casting (Diane France), Fort Collins.

Tal, H. & Tau, S. (1984). Tooth Loss and Tooth Retention in a Multitribal Group of Bantu-Speaking South African Blacks: A Study of 500 Dry Mandibles. American Journal of Physical Anthropology 64: 75-82.
Termine, J.D. & Posner, A.S. (1966). Infra-Red Determination of the Percentage of Crystalinity in Apatitic Calcium Phosphates. Nature 211: 268-270.
Thrupp, S.L. (1962). The Merchant Class of Mediaeval London. University of Michigan Press, Lansing.
Trotter, M. & Gleser, G.C. (1952). Estimation of Stature From Long Bones of American Whites and Negroes. American Journal of Physical Anthropology 10: 463-514.
Trotter, M. & Gleser, G.C. (1958). A Re-Evaluation of Stature Based on Measurements of Stature Taken During Life and Long- Bones After Death. American Journal of Physical Anthropology 16: 79-123.
Turner, C.G. (1979). Dental Anthropological Indications of Agriculture Among the Jomon People of Central Japan. American Journal of Physical Anthropology 51: 619-636.
Ubelaker, D.H. (1978). Human Skeletal Remains. Aldine, Chicago.
Vallois, H.V. (1965). Anthropometric Techniques. Current Anthropology 6: 127-143.
de Villiers, H. (1968). The Skull of the South African Negro. A Biometrical & Morphological Study. PhD Thesis, University of the Witwatersrand. Witwatersrand University Press, Johannesburg.
Waldron, T. (1985). DISH at Merton Priory: Evidence for a "New" Occupational Disease? British Medical Journal 291: 1762-1763.
Waldron, T. (1987). The Relative Survival of the Human Skeleton: Implications for Palaeopathology. In (Boddington, A., Garland, A.N. & Janaway, R.C., eds) Death, Decay & Reconstruction. Manchester University Press, Manchester.
Waldron, T. (1988). The Human Remains From Great Chesterford, Cambridgeshire. AM Lab Report 89/88.
Wells, C. (1980). The Human Bones. In (Wade-Martins, P.) Excavations at North Elmham Park, 1967-72. East Anglian Archaeolgical Report No. 9. pp. 247-374.
West, B. (1990). The Human Bones. In (Ward, S.W., ed) Excavations at Chester. The Lesser Mediaeval Religious Houses. Sites Investigated 1964-83. Grosvenor Museum Archaeological Excavation & Survey Reports No. 6. pp. 127-137.
White, W. (1988). The Cemetery of St Nicholas Shambles. BAS, Over Wallop.
Whittaker, D.K., Molleson, T., Bennett, R.B., Ap Edwards, I., Jenkins, P.R. & Llewelyn, J.H. (1981). The Prevalence & Distribution of Dental Caries in a Romano-British Population. Archives of Oral Biology 26: 237-245.
Whittaker, D.K., Molleson, T., Daniels, A.T., Williams, J.T., Rose, P. & Resteghini, R. (1985). Quantatative Assessment of Tooth Wear, Alveolar Crest Height and Continuing Eruption in a Romano-British Population. Archives of Oral Biology 30: 493- 501.
Williams, H.U. (1932). The Origin and Antiquity of Syphilis: the Evidence From Diseased Bones. Archives of Pathology 13: 778- 814 & 931-983.
Wiltse, L.L. (1962). The Etiology of Spondylolisthesis. Journal of Bone & Joint Surgery 44A:

539-560.
Workshop of European Anthropologists (1980). Recommendations for Age & Sex Diagnosis of Skeletons. Journal of Human Evolution 9: 517-549.
Wynne-Davis, R. & Gormley, J. (1978). The Aetiology of Perthes' Disease. Journal of Bone & Joint Surgery 60B: 6-14.
Wynne-Davis & Scott, J.H.S. (1979). Inheritance and Spondylolisthesis: Radiographic Family Survey. Journal of Bone & Joint Surgery 61B: 301-305.

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**PLATES (see digital file of jpg images)**

Plate 1: The scapulae of burial 2624 *(EH B910594, Mar 1991)*
Plate 2: Thoracic vertebrae of burial 1417 showing changes suggestive of diffuse idiopathic hyperostosis (DISH) *(EH B910593, Mar 91)*
Plate 3: The tarsals and metatarsals of burial 0985 showing erosive and some proliferative lesions *(EH B910612, Mar 91)*
Plate 4: The tibiae of burial 0985 (lateral view) showing periostosis *(EH B910621 Mar 91)*
Plate 5: The hand bones of burial 1754 showing erosive lesions *(EH B910637 Mar 91)*
Plate 6: Radiograph of the hand bones of burial 1754 (*EH B910600 Mar 91)*
Plate 7: Details of erosive lesions in (from left to right on the photograph) ulnar facet of the distal right radius, distal left radius, left hamate, distal left ulna and left trapezoid of burial 1754 *(EH B910627 Mar 91).*
Plate 8: The ankylosed right sacro-illiac joint of burial 1827. *(EH B910595 Mar 91)*
Plate 9: Two hand phalanges from burial 2466 showing erosive lesions at their distal ends
Plate 10: The foot bones from burial 2656 showing proliferative and erosive lesions (*EH 910613 Mar 91)*
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Plate 12: The $12^{th}$ thoracic and $1^{st}$ lumbar vertebrae of burial 2458 showing erosions on their bodies suggestive of Scheuermann's disease (*EH B910641 Mar 91)*
Plate 13: A radiograph of the left hip of burial 1917 (anterior view). The femoral head shows Perthes' disease and there is sever osteoarthritis, with the formation of large marginal osteophytes, on the femoral head and acetabulum (*EH B910633 Mar 91*)

Plate 14: Metatarsals and hallucial phalanges of the right foot of burial 1962: there is market lateral deviation of the proximal hallucial phalanx – hallus valgus. There is also osteoarthritis at the 1st metatarso-phalangeal joint (*EH B910614 Mar 91*).
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Plate 16: Shoulder joints of burial 0938 showing severe osteoarthritis (*EH B910626 Mar 91).*
Plate 17: Medial surface of an unhealed weapon injury on the cranial vault of burial 1749 (*EH B910623 Mar 91).*
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Plate 19: The cranial vault of burial 2491 showing an iron fragment embedded in the left side of the frontal bone (*EH B910608, Mar 91).*
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Plate 22: The forearm bones of burial 1904. The right ulna and radius end in a stump due to amputation of the right hand. (*EH A881454 Dec 88*)
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Plate 35: The tibiae of burial 1965 showing the pattern of bone deposition on the lateral surfaces with apparent bridging over superficial blood vessels (EH A891389 Oct 89)
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