7 THE BURIALS

7.1 THE BURIALS AT ABERDEEN, LINLITHGOW AND PERTH FRIARIES JA STONES

INTRODUCTION

The excavations at the Carmelite friaries of Aberdeen, Linlithgow and Perth provided an opportunity to study the health status, stature and pathology of a sample of the population of Scotland from the 13th-17th centuries, and also explore the rituals and customs according to which they were interred.

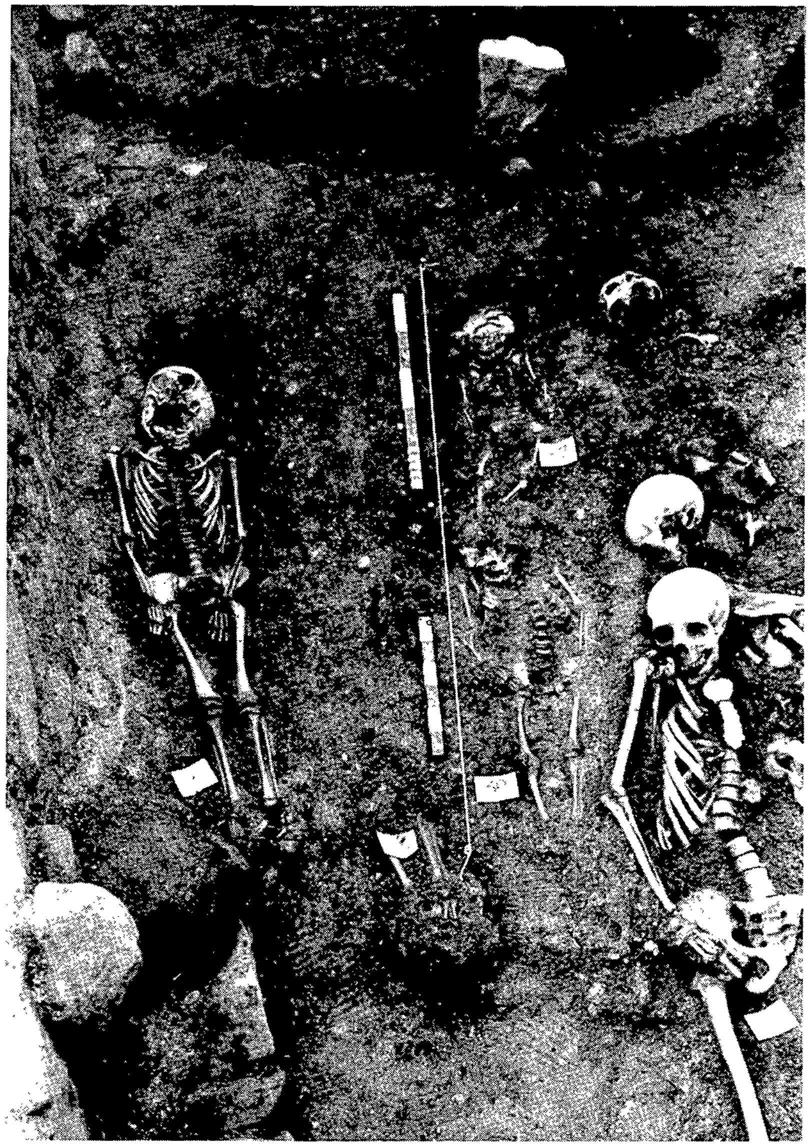
The first four sections of this chapter (7.1-7.4) discuss the burials from the viewpoint of the archaeologist. Their dating, their possible identity within the population of medieval and post-medieval Scotland, as well as the manner in which they were interred are discussed in this initial portion of the chapter. In microfiche (1:B12-D5), Chapter 7.2 attempts to examine in detail the complex inter-relationships of the burials at Linlithgow. As has been explained in the relevant site discussion (Chapter 4.2) no such attempt has been made at Aberdeen because in the absence of a tenable stratigraphic sequence it was not felt worthwhile. At Perth, where only a small number of burials were excavated, all necessary detail is incorporated in Chapter 6.2. Perth was notable, however, in producing remains of wooden coffins; one, which seems to have constituted a grave lining rather than a portable box, was sufficiently well preserved to allow a reconstruction drawing to be done (Ill 52). A summary of these Perth finds appears in print (7.3) and a more detailed discussion in microfiche (7.4; 1:D6-E4).

The latter portion of this chapter examines the human remains themselves. In 7.5 the skeletal data from all three sites is assessed in what it is hoped are terms intelligible to the layman, as well as to the specialist, and illustrated, while the detailed skeletal analysis appears in microfiche. Chapter 7.6 is set at the beginning of the microfiche skeletal material (1:E5-G3) and explains its layout.

DATING

At all three sites the date range of the burials is a complicated issue. At Aberdeen, the friary was a late 13th-century foundation. Perth was also established in the 13th century, while the Linlithgow friary seems to have originated early in the 15th century. All three came effectively to an end at the Reformation in 1559. However, at all the sites burials took place not only during the friary period, but after, and in the case of Linlithgow, before the establishment of the friary.

At Linlithgow some burials date from the 13th century and were associated with the chapel which was later to become part of the friary church (see Chapter 5.2). At all three sites burial seems to have continued after the Reformation. At Aberdeen and Linlithgow, burials continued to be made at least into the 17th century, while at Perth some burials may have been made beyond even this date (see Chapters 4.2, 5.2, 6.2). At Aberdeen, some post-Reformation interments may be those of victims of plague or famine, while at Linlithgow some may be associated with use of friary buildings in the years after 1559, while others may have resulted from continued veneration of the site even after the friary had been demolished. At all three sites it is clear that, for various reasons, burial continued after the Reformation and was not actively discouraged.



ILL 49 : Burials at Aberdeen friary

FRIARS OR LOCAL POPULATION?

In the post-Reformation period, it was a section of the local population rather than the friars (except perhaps at Linlithgow where some of them may have lingered after 1559 to die and be buried on site) which was being interred in the friary buildings and precincts. But during the friary period at all the sites females as well as males were being interred, and at Linlithgow and Aberdeen, children also. At Aberdeen there were considerable problems in distinguishing between burials made before and after the Reformation, but it is likely that some of the twenty-two females and children identified among the skeletal remains belong to the friary period. At Perth, within Building 1, thought to be the church, were eleven burials, of which about half were of females, while external graves of the friary period also included at least one female. At Linlithgow, female and child burials occurred in the chancel and the claustral area as well as in the graveyard.

During the medieval period, the right to bury lay people was often guarded by the parish church, as it provided a useful source of finance in the form of burial dues. It was the cause of a long controversy between the Franciscan order and the secular church which culminated in a Papal decree of 1312 to the effect that laymen could be buried within the friary cemetery subject to the condition that the friars handed over a proportion of the amount received by them in respect of the burial (Bryce 1909, 430). We do not fully know how the Carmelites fared in their relationships with parish churches, nor what local conditions were like at the three Scottish sites concerned, but clearly at the time that burials were taking place there under the auspices of the friars, from the 14th century onwards, conditions must have been fairly relaxed. At Linlithgow, we have evidence of a good working relationship between the friary and the town, at least, in the appointment of Prior Hopper as a burgess in the 16th century, while at Perth a special situation may have existed because of the deep involvement of the Bishop of Dunkeld in the friary.

BENEFACTORS

From documentary sources (Bryce 1909, 317) there is some evidence that both male and female benefactors of religious houses were buried in a prominent position, in front of an altar which they had particulary supported.

At Perth there may be some evidence for this practice in the group of 13th-century burials (an equal mixture of males and females) before what may have been the high altar of the church, particularly as three of them were in plank-lined graves. At Linlithgow, only about twenty people seem to have been interred in the chancel of the friary church during Period 3, a span of some 140 years in the 15th and 16th centuries. This in itself might suggest, as one might expect, that burial in this place might be reserved for highly esteemed or beneficent individuals. Males and females were included in this group and most striking is the only burial in the presbytery, that of a young female laid to rest N of the altar, surely a person of some distinction.

At Aberdeen the wide date range makes it impossible to detect whether the burials might have been those of benefactors. If Building 1 is the church, then we might expect burial of benefactors nearer the E end, in the area which was not excavated. None of the present sites have produced burials as prestigious as those recorded in the early 19th century on the site of the Aberdeen Dominican friary, where 'an ancient grave . . . roughly built of large hewn stones, cemented with lime . . . contained the remains of three bodies, one of them, from the appearance of the skull, apparently very young' (*Aberdeen Journal,* 24th April 1833, 3). It has been suggested that this might be the burial place of the Earls Marischal of Scotland, who were by some accounts buried among the Dominicans (Milne 1911, 78).

Another attested method of burying important people within friaries was in mural tombs. There are many fine surviving Irish examples, for example a Connacht tomb at the Dominican friary at Strade, Mayo (Leask 1960, 168, pl XXVIa) and a tomb associated with the O Dalys at Kilconnell (Leask 1960, 167, pl XXIVa). At Blackfriars, Newcastle, there are a number of grave recesses in the N and S walls of the nave (Harbottle and Fraser 1984). At Luffness, there is an effigy (possibly of a founder) set into the wall of the N side of the presbytery (MacGibbon and Ross 1896-7, 2, 289). At Perth and Linlithgow, disturbance of bones from mural tombs has been suggested as a means of interpreting the finding of two skeletons in a wall-robbing trench and a ditch respectively (see Chapter 6.2, p 100; 5.2, p 57).

FRIARS

Another group whose remains we might hope to identify are the Carmelites themselves. From evidence elsewhere, we might expect some of them, for example the priors, to have been interred in the chapter house, or the claustral area, and the remainder in a specially designated part of the friary cemetery.

Only at Linlithgow have a chapter house and claustral area been positively identified. Although there were burials of friary date within this area, they included females and children and it is difficult to identify any particular group as the friars. Apart from burial in a designated location, we might expect that friars would have been interred in their habit rather than a shroud. At the Austin Friary, Leicester, friars were identifiable by the remains of buckles near their pelves (Mellor and Pearce 1981, 22). Their rule required them to wear leather belts rather than the knotted cord associated for example with the Franciscans. At Aberdeen a number of skeletons had green marks on individual bones associated with decayed copper objects. Two of these stains appeared on the pelvic bone of male skeletons and could conceivably be the result of a decayed belt buckle, as could an extensive stain on the radius and ulna around the elbow joint of another. However, the majority of these stains appeared elsewhere on the skeleton. At Linlithgow a number of belt buckles were recovered during the excavation, but none of these was directly associated with a burial.

A number of the friars would also have been in holy orders, and according to some traditions would therefore have been buried the opposite way round to their layfolk, with their feet to the W. However, Rahtz (1978, 4) suggests that this practice was not widespread before the Reformation and there is no evidence for it at these three sites. At Linlithgow a few burials were made in this position, but they were not all men and it seems more likely that their position resulted from mistake, or heavy shrouding rather than from reversed burial of priests.

CONFRATERNITY

The problem posed by the extensive site and relatively large building complex at Linlithgow in relation to the small number of friars thought to have been active in Scotland has already been mentioned (see Chapter 2). We do not know the position in Scotland, but it seems that from at least the later 15th century the concept of confraternities composed of family groups living according to the rule was accepted by the Carmelite order (Baudrillart 1949, 1087) and that the entry of boys from eight years old as oblates was also regarded as desirable. These factors ought to be borne in mind when considering the identity of the people buried within the friary buildings and precincts, particularly in the case of females and immature individuals.

SHROUD OR COFFIN?

It is clear that in most medieval contexts coffin burial was by no means universal and that a large number of burials were uncoffined. In some cases this form of burial may have been at the direct request of the deceased, as in the case of a 15th-century Rector of St Helen-on-the-Walls, Aldwark, York, who specifically forbade 'my executors to prepare for my body a wooden coffin or any other covering except a sheet in which to wrap my body' (Magilton 1980, 9).

At Aberdeen, of the fifty individuals sufficiently undisturbed to allow judgement to be made on the subject of coffins, only fifteen could be said to have positive evidence of having been interred in a coffin, either in the form of a dark outline or in presence of nails surrounding an individual skeleton. These fifteen probably coffined burials included only one infant, one child and one young juvenile.

However, there were in addition a large number of nails recovered from general layers associated with the burials but not with any particular skeleton. In the absence of any real stratigraphic relationship between burials it is difficult to judge whether there is any correlation between date of the burial and presence/absence of a coffin. However, the two skeletons which produced radiocarbon dates in the ranges 1395 ± 50 ad and 1460 ± 50 ad (see Chapter 7.9 mf, 5:E4) both had surrounding groups of nails, whereas skeletons with apparently later dates (1560 ± 50 ad; 1610 ± 50 ad) showed no evidence of coffins. In the case of Aberdeen therefore, it is possible that coffins were used more during the friary period than in the post-Reformation period. They seem to have been used less for children than for adults.

In post-Reformation Aberdeen it was cheaper to bury a child without a coffin. In 1603 Aberdeen Burgh Council laid down burial charges for St Nicholas Church: for a child under 14 years, with a coffin, £3 was due, but for a young child with no coffin only 20/- was charged (Gordon 1984, 166). This may well have continued a pre-Reformation practice. At Perth there were only three coffined burials in the friary period, and they were in plank-lined graves before what may have been the high altar. Here coffins would perhaps have been used for reasons of prestige; although it is interesting that two plank-lined coffins were also encountered in post-Reformation contexts on the same site. At Linlithgow there is no evidence of coffins having been used during the friary period, not even in the case of the young female buried in the presbytery in what was clearly a prestigious position. However, there was some evidence for coffined burials during the pre-friary period.

The plank-lined graves at Perth perhaps indicate that the choice was not necessarily between a coffin in the modern sense and no coffin. At Hereford (Shoesmith 1980, 30) it has been suggested that burial was made on a flat wooden bier, or that some coffins may have been held together by wooden dowels, neither of which arrangements would necessarily leave archaeological evidence. In immediately post-Reformation Scotland the concept of a re-usable coffin or bier was certainly known, and may have continued an earlier tradition. In 1563, the General Assembly of the Church of Scotland passed an Act ordaining that a bier should be made in every country parish to carry the dead prior to burial (Gordon 1984, 32). This may have implied a flat bier or 'stretcher' or a more elaborate common coffin, a box of wood or iron whose top, side or bottom opened to allow the body to be placed in the grave (Gordon 1984, 32). A closed common coffin could, if deposition of the body went slightly wrong, account for some of the prone burials at Linlithgow. By coincidence, one of the last common coffins in Scotland survived until about fifteen years ago at Linlithgow (Gordon 1984, 33).

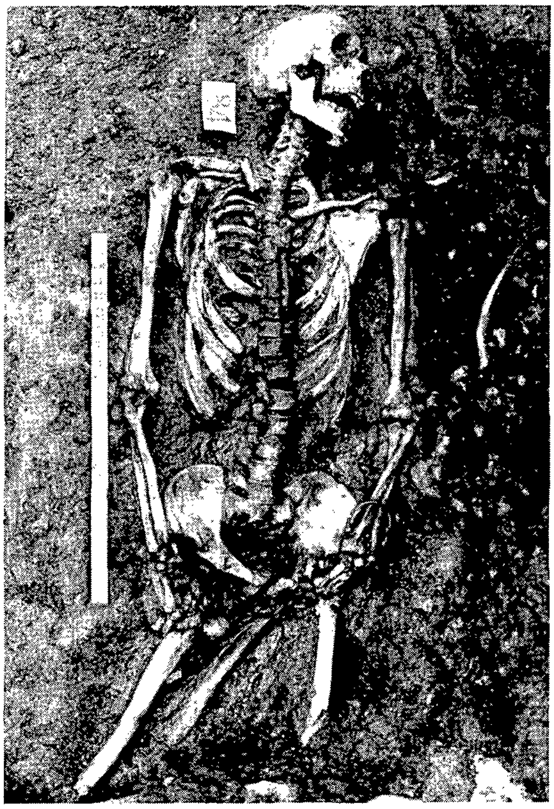
SHROUD FASTENINGS

Where individual coffins were not used, burial was probably made in a shroud, whether of leather, linen, or other material, a habit (in the case of a religious) or in ordinary clothes. A number of small objects, such as copper alloy lace-ends and pins, were found in burial contexts at all three sites, and are in these cases probably related to burial clothing. Whether the lace-ends suggest burial in, for example, a laced doublet, or burial in a shroud fastened with laces, is very difficult to say. At Linlithgow a group of twisted wire rings may have been used for shroud fastening. However, it should be added that the evidence for fastening or clothing corpses is very minimal, considering the number of burials excavated at all the three locations, and even considering the speed with which small copper objects might deteriorate in the ground.

Many pages have been covered elsewhere with discussion of the significance of the position of arms and hands, whether at the sides, across the chest, or across the pelvis. At these three sites the usual variety was encountered, but no particular relationship was detected between position of limbs and status, or age, sex or indeed presence or absence of a coffin. All the burials were supine with the feet to E, the few exceptions at Linlithgow being probably the result of heavy shrouding of the corpse, perhaps in leather, or a temporary coffin, resulting in interment the wrong way round.

GRAVE MARKER

Relatively few external burials were excavated at Linlithgow and Perth and no grave markers were identified. However, at Aberdeen a small stone was found upright at the head of the burial place of two small children (SK 32 and SK 37). As it is thought that burial may have been carried out at Aberdeen in the empty shell of Building 1 after the Reformation, and as SK 32 and SK 37 seem to be amongst the latest burials, it seems fair to suggest that this stone is indeed an *ad hoc* attempt at a grave marker.



ILL 50 : Aberdeen. Bracelet (*134*) on left wrist of SK 84

ILL 51 : Aberdeen. Possible grave marker adjacent to SK 32 and SK 37.

7.2 LINLITHGOW: THE BURIALS WJ LINDSAY

In microfiche 1:B12-D5

7.3 PERTH: THE WOODEN COFFINS WE BOYD

SUMMARY

At the Perth friary site five of the skeletons had been interred in coffins. SK 10, SK 11 and SK 20 (Ill 44) were buried within Building 1, the probable church, during Period 1 (13th century). SK 5 and SK 7 were cut through demolition layers at the N end of the site in Period 4 and may be as late as the 18th century (see Chapter 6.2). Wood samples examined included remains of the coffins of SK 7 (context 90), SK 10 (context 169) and SK 20 (context 207). Only sufficient remained from coffin 207 for it to be reconstructed, the other two being fragmented, but all three may have been of a similar type.

COFFIN 207 (Ill 52, 53mf)

The c 1.30m length excavated revealed a roughly trapezoidal coffin which is estimated to have been c 1.70m (c 5′6″) in total length. The excavated narrow end was c 0.28m wide with the wider 'head' end being an estimated c 0.41m wide. It was c 0.16-0.17m in depth.

It was constructed with a slatted base of probably eight separate boards of which six have been recovered (*e, d, c, f, l,* and *m*). These became progressively wider towards the 'head' end and the distance between them narrowed. Over the base boards were placed two side boards (*a* and *b*) which were wedged apart at the narrow end by a single end board (*k*). Fragments of a lid were found. All the wood is of radially split planks of *Quercus* (oak) being typically wider along one edge.

Each of the base boards has a peg-hole in either end, except for *d* and *m* where they may have been lost through damage at one end. The peg-holes are typically round and tapered in section (c 10 and 15mm in diameter) although the peg-hole in *d* may have been made by a large headed square-shanked nail. These peg-holes do not appear to have been constructional as they lie outside the sideboards apart from *m* where sideboard *a* lies over the hole. Sideboard *b* also has a peg-hole at the narrow end of the coffin but there is no corresponding hole in end-board *k*. No traces of any pegs were found.

Four of the base-boards (*d, c, f* and *l*) have nail holes in them; one on board *f* does not penetrate the wood and is on the underside. Both sideboards had traces of at least one nail hole apiece on the underside. None of these nail holes appear to have had any constructional purpose and no traces of nails were found.

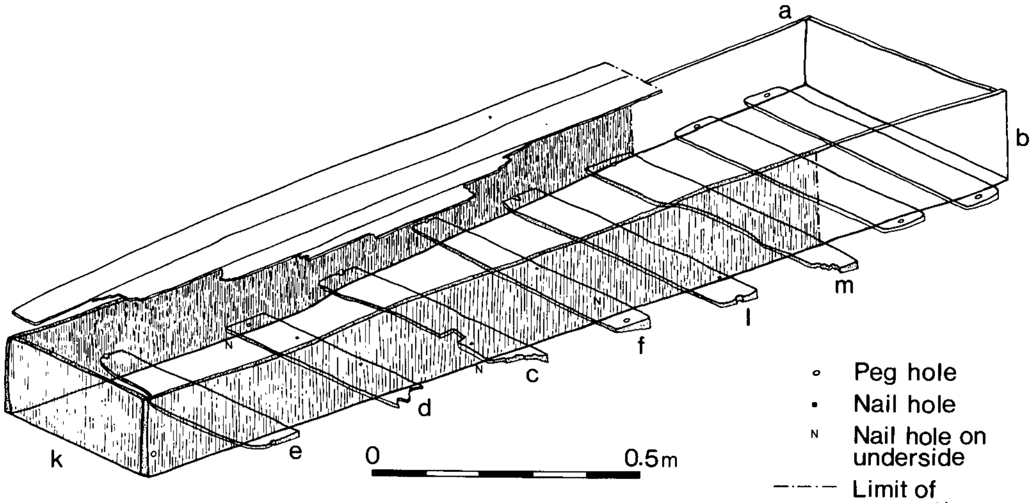
Base board *c* also has a notch cut out of one side. A number of faint roughly parallel compression marks can be seen on the base boards running the length of the coffin. They are similar to those caused by the weight of the side boards and are found on the upperside of the boards except on *f* where they are on the underside.

These various features suggest that the wood had already been used for something else, perhaps another coffin, given the shape of the base boards and the occurrence of parallel compression marks. The lack of pegs and nails, and the fact that virtually all of the peg and nail holes do not line up suggest that this was not a portable coffin as such, but more of a grave lining: first the base boards would have been placed in the bottom of the pit and the side boards would then have been placed over them and wedged apart by the end boards. Some backfilling or similar would have been necessary to prevent the side boards from falling outwards. Given the nature of the clay into which the grave had been dug it is unlikely that this wooden lining was required for structural reasons but probably served a 'social' function, perhaps to make the grave look more impressive.

The lid was constructed of probably more than one board running the length of the coffin (up to 9mm in thickness cf up to 20mm for the rest of the coffin). It had also been partially carbonised perhaps to harden the wood for durability or for the same aesthetic/social reason already suggested.

COFFIN 169

The wood of this coffin constituted radial slivers of a dicotyledonous wood, probably *Quercus* and of *Pinus sylvestris* (Scotch pine), much distorted and carbonised. The surface of some of the *Pinus* fragments appears to be a veneer or the result of treatment by some process such as heat-hardening, tarring or by a chemical process.



ILL 52 : Perth. Reconstruction drawing of coffin 207

COFFIN 90

The bottom slats of this coffin and its sides were of radial slivers of probably *Quercus*, which was partially carbonised. The lid was made from *Pinus sylvestris*.

ARCHAEOLOGICAL PARALLELS

The use of wooden coffins and wood linings in graves has a long tradition in Britain. By the medieval period nailed coffins were the common form, although sometimes too few nails appear to have been used. Rodwell comments that a nailed coffin cannot be made with less then a dozen nails (1981, 152), but there is always the difficulty of differential loss of metallic objects or the use of nails for only part of the construction eg for fastening the lid down. The only example of an entirely pegged coffin has come from Bordesley Abbey, Redditch (Hirst 1976, 213, fig 41). Coffins with open slatted bases of probable 15th-century date have been recovered from St Giles Cathedral, Edinburgh (N Holmes, pers comm). Here usually ten base boards were overlain by longitudinal side boards wedged apart by an end board composed of several upright boards. Although similar in style to the Perth coffin 207 they were fully nailed and would have functioned as portable coffins. Other comparable but nailed coffins with five or six base boards have been found in the church graveyard at Søndre Gate, Trondheim, Norway (Long 1975, 16).

There do not appear to be any other examples of an unjointed nail-less wooden grave-lining from post-conquest Britain.

Oak was commonly used for coffins during this time and earlier, but other wood is known, eg *Picea abies* (silver fir), *Pinus* (pine), *Tilia* (lime) and *Ulmus* (elm).

OTHER WOOD SAMPLES

Eight other contexts yielded wood samples. Of interest is the possible coffin wood from Period 3 context 41. This comprises three large fragments of *Quercus* tangentially cut and probably sawn. One fragment has two almost circular and tapered peg-holes. A large quantity of possible wood-working off-cuts came from the backfill of a drainage ditch, context 142, from which a small sub-sample yielded *Pinus sylvestris*, *Quercus* and *Fraxinus* (ash). The floor fragments from the clay dump between floors in Building 3 were all of *Pinus* including *Pinus sylvestris*. One fragment of *Taxus baccata* (yew) may have been from a yew tree planted in the friary grounds (cf at Hulne (Hope 1890, 117) and Muckross, Kerry (Leask 1960, fig 38)) and two small branch fragments of *Crataegus* (hawthorn) probably came from a nearby hedge. A piece of a small stake or peg of *Prunus avium* (wild cherry) was found in context 77, associated with SK 7.

7.4 PERTH: THE COFFINS AND OTHER WOOD SAMPLES WE BOYD

In microfiche 1:D6-E4

7.5 THE SKELETAL REMAINS JF CROSS & MF BRUCE

INTRODUCTION

The burials from Aberdeen were excavated from a small area within the walls of Building 1. Although many of the articulated skeletons were recovered intact, there were also substantial numbers of conmingled disarticulated bones (Ill 49). This was no doubt due to the close layering and to previous disturbance of the burials. During the excavation, 126 burials in a good state of preservation were recorded on site and numbered with the prefix SK. Details of these, together with the metric and non-metric data, are found in the microfiche (Chapter 7.7mf, 2: A3-5: D6). A further five SK burials were excavated in 1986 from a site at 19-25 Hadden Street which would have been within the precincts of the Carmelite friary. Unfortunately, this material was so fragmentary that little information could be obtained (Chapter 7.8mf, 5: D7-E3).

A considerable number of the burials at the Linlithgow site were recovered from well-defined though truncated grave cuts. A large proportion of the burials within the confines of the friary buildings was recovered, together with a number of the external burials lying near the N and E walls of the friary church. Burials were also recovered from within the pre-friary chapel. The skeletons were generally only moderately well preserved, thereby reducing the amount of information that could be recorded. At Linlithgow 207 SK burials were excavated (Chapter 7.10mf, 5: F1-10: F12).

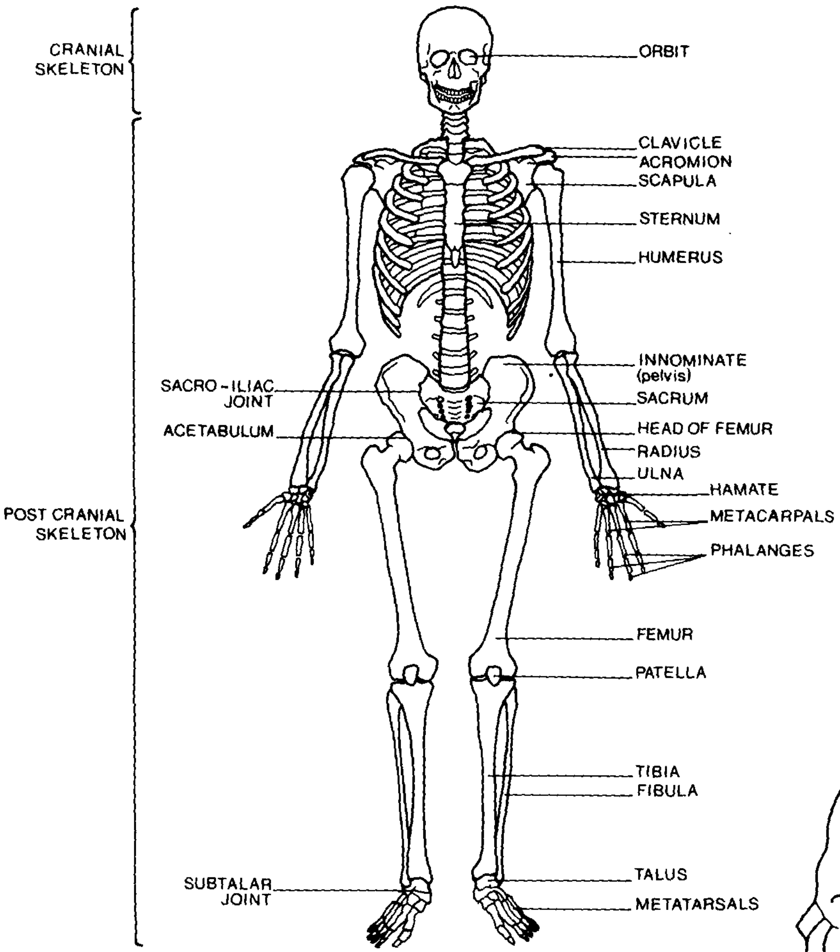
In Perth, single burials were excavated from within and outwith the friary buildings. Twenty-four SK burials were recovered but relatively few data could be obtained as the condition of the bones was poor (Chapter 7.11mf, 10: G1-11: F6).

NUMBER OF INDIVIDUALS

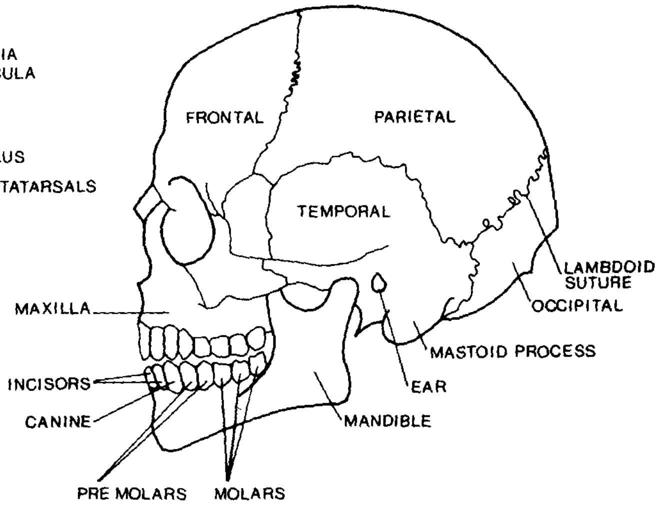
Post-excavation analysis of the skeletons showed some discrepancy between the number of SK burials reported in the field and the number studied in the laboratory. An SK number is the original skeleton number assigned to the skeletal material as it was uncovered during the course of the excavation. On two occasions, there was sufficient evidence to show that two SK burials in fact represented only one individual, e.g. SK 4 and SK 81 in Aberdeen and SK 30 and SK 31 in Linlithgow. Where this occurred, the higher SK burial number was eliminated. There was also a small number of cases (six in Aberdeen and in Linlithgow, three in Perth) in which the SK burial was not recovered for subsequent analysis, although it had been included on the site plans.

An SK burial number need not refer to a complete skeleton—it may have been assigned to a partially complete articulated skeleton, to a disarticulated skull or to an assemblage of disarticulated bones. In Aberdeen and in Linlithgow, where a series of disarticulated skulls was found, each skull in the series was assigned an SK burial number. It is of course likely that these skulls were from some of the 'skull-less' SK burials in the vicinity. Unfortunately it was not possible to match them using the rigorous criteria employed in this study (Chapter 7.6mf, 1: E5-G3).

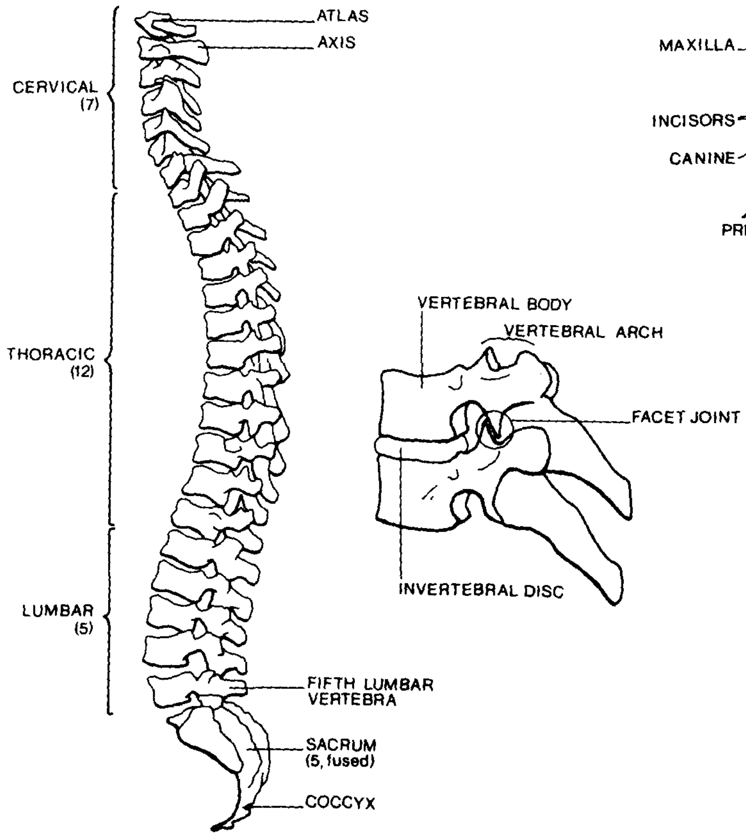
Since an SK burial did not always represent one individual, it was necessary to determine a minimum element count to estimate the minimum number of individuals represented in each of the three collections. This count was based on the number of non-replicated skeletal elements and included all disarticulated bones as well as the material from the SK burials. Thus in the Aberdeen collection, there were at least 93 individuals present, of whom 39 were immature and 54 were adult (Table 7). The actual number is likely to have been somewhat greater, given the nature of the material.



ILL 54 : The human skeleton



ILL 56 : Left side of the skull



ILL 55 : Side view of the vertebral column

The minimum number estimate in the Linlithgow series was 227 individuals (144 immatures, 83 adults). This is probably a good estimate of the numbers represented as a large proportion of the burials were recovered from clearly defined grave cuts. Similarly, the estimate of 24 (2 immatures, 22 adults) is likely to be a fair estimate of the numbers of individuals present in the Perth collection.

Table 7 Minimum element count of individual bones, combining the SK burials and the disarticulated bones, to give an estimate of the minimum number of individuals represented in each collection.

	IMMATURE	n	ADULT	n	TOTAL
ABERDEEN	Right innominate	39	Left innominate	54	93
LINLITHGOW	Right temporal	144	Left temporal	83	227
PERTH	Right proximal femur	2	Left proximal tibia	22	24

TIME SPAN

In many studies of archaeologically derived human skeletal material, all the burials from one site are often treated as if they represent a cross-section of the population. Comparison of the three sites was made on this premise. However, the excavated material more accurately represents a lineage sample of the population, which spans the length of time the site was used as a burial ground. In Aberdeen, the burials span a period from the late 14th to the early 17th century, while the Perth collection covers a period beginning in the 14th century and continuing at least into the 17th century. At Linlithgow the burials range in date from the 13th century until the early 17th century.

The earliest evidence of burials at Linlithgow occurs during Phase 3 of the pre-friary Period 2, while the latest burials appear to be of Period 4 date. Attempts were made to compare the earlier and later burials which spanned some 300-400 years. Similarly, comparisons were made between the friary and the post-friary burials at Perth. Unfortunately, the disturbed stratification of the burials in Aberdeen made it difficult to separate them into different periods with any certainty.

SAMPLING BIAS

The extent of the excavation, together with the degree of disturbance and the condition of the skeletal material differed in each site. These, and other factors, influence the extent and nature of the information that may be obtained from each collection, consequently introducing sampling biases. These biases must be borne in mind when comparisons within and between the three sites are made.

DATA PRESENTATION

Age and sex profiles for each site were based on the information from the SK burials only. The metric and non-metric data detailed below and in the microfiche were obtained from all available skeletal material, including both the SK burials and the disarticulated material.

Illustrations 54, 55 and 56 have been placed on a fold-out for use as reference throughout the skeletal section.

AGE AND SEX PROFILES

AGE-AT-DEATH DISTRIBUTION

Standard criteria were used to determine age-at-death for each SK burial. In the immature material, the degree of dental and skeletal maturation was assessed following Brothwell (1981), Williams and Warwick (1980) and Ubelaker (1978). The material was then assigned to one of seven age categories ranging from Foetal to Subadult (Table 8).

No attempt was made to determine chronological age-at-death in the adult material. Generally, ageing techniques are not sufficiently discriminatory to provide accurate age-at-death estimates, particularly in fragmentary remains. Age assessment in this study was based on the degree of degenerative change, or wear and tear, shown by the skeletons (Ill 57).

Adult SK burials were assigned to one of three broad age categories: Young, Middle-aged, Old. In some cases, it was possible only to assign an SK burial to one or other of the broader categories of Immature or Adult (Table 9).

The age distribution of the SK burials from each site, excluding the two broad categories of Immature and Adult, is shown in Ill 58. No foetal or perinatal SK burials were present in the Aberdeen collection, although some foetal material was found amongst the disarticulated bones. Over one third (36%) of the entire sample of SK burials was probably less than 18 years of age at death. Both foetal and perinatal skeletons were present in the Linlithgow series where over a half (58%) of the SK burials had failed to survive

ILL 57 : Series of thoracic vertebrae showing increasing lipping (left to right) around margins of the vertebral bodies, illustrating age-related degenerative changes of the vertebral column

beyond 18 years of age. In Perth, no SK specimens under 18 years of age were found, although the disarticulated remains of at least two immature individuals were represented in the collection (Table 7).

From Table 10 it can be seen that over half of the individuals under 18 years in fact died before the age of six (53% in Aberdeen, 63% in Linlithgow), and about a quarter or more of these died before the end of their second year (23% Aberdeen, 40% Linlithgow).

These figures are comparable with British Anglo-Saxon/medieval sites (McWhirr et al 1982). In the pre-antibiotic era, respiratory infections and gastroenteritis were probably the chief causes of high childhood mortality (Manchester 1983).

The large proportion of foetal and perinatal burials in the pre-friary chapel at Linlithgow is particularly interesting (see Chapters 5.2, 7.2mf, 1: B12-D5). Some of these individuals were as young as five to seven months (intra-uterine). It is possible that they were born alive, but they probably did not survive long. Unfortunately it was not possible to ascertain whether the perinatal individuals (seven months intra-uterine to two months after birth) represent live or stillbirths.

Subadult SK burials (18-25 years) were included with the adult age groups since skeletal and dental development is virtually completed by this time. In the adult sample, therefore, over half of the SK specimens (50% Aberdeen; 58% Linlithgow; 53% Perth) died while they were relatively young (Table 10). Less than a quarter of the adults reached middle age and beyond. Few survived to old age.

It is difficult to draw firm conclusions from these figures since about one quarter of the entire adult sample had to be assigned to the general category of Adult because of insufficient skeletal evidence on which to base more specific estimates. The high mortality rate in young adults may reflect deaths in childbirth in young women and occupational and lifestyle factors in young men. Adults reaching middle or old age probably represent those individuals who developed immunity to epidemic diseases such as cholera or typhoid.

Table 8 Age categories, showing the age range and the abbreviations (in parenthesis) used in the figures.

AGE CATEGORY	ABBR.	AGE RANGE
Foetal	(FO)	0-7 months intra-uterine
Perinatal	(PE)	Birth +/− 2 months
Infant	(IN)	2 months-2 years
Child	(CH)	2-6 years
Young Juvenile	(YJ)	6-12 years
Old Juvenile	(OJ)	12-18 years
Subadult	(SA)	18-25 years
Young Adult	(YA)	Skeletal and dental maturity reached. No degenerative change.
Middle-aged Adult	(MA)	Minor to moderate degenerative change.
Old Adult	(OA)	Severe degenerative change.
Immature	(IM)	Skeletal or dental development not completed.
Adult	(AD)	Skeletal or dental development completed.

Table 9 Distribution of SK burials assigned to the two broad age categories of Immature or Adult.

	ABERDEEN (n = 120)		LINLITHGOW (n = 201)		PERTH (n = 21)	
AGE CATEGORY	n	%	n	%	n	%
Immature	1	1	10	5	0	0
Adult	15	13	14	7	8	38

Table 10 Age distribution of the immature and of the adult SK burials respectively. Subadult specimens have been included with the adult SK burials.

	ABERDEEN		LINLITHGOW		PERTH	
IMMATURE	n	%	n	%	n	%
Foetal	0	0	5	4	0	0
Perinatal	0	0	13	11	0	0
Infant	10	23	30	25	0	0
Child	13	30	27	23	0	0
Young Juvenile	13	30	14	12	0	0
Old Juvenile	6	14	20	17	0	0
Immature	1	2	10	8	0	0
Total	43		119		0	
ADULT						
Subadult	11	14	14	17	1	5
Young Adult	28	36	34	41	10	48
Middle-aged Adult	18	23	13	16	1	5
Old Adult	5	4	7	9	1	5
Adult	15	20	14	17	8	38
Total	77		82		21	

SEX DISTRIBUTION

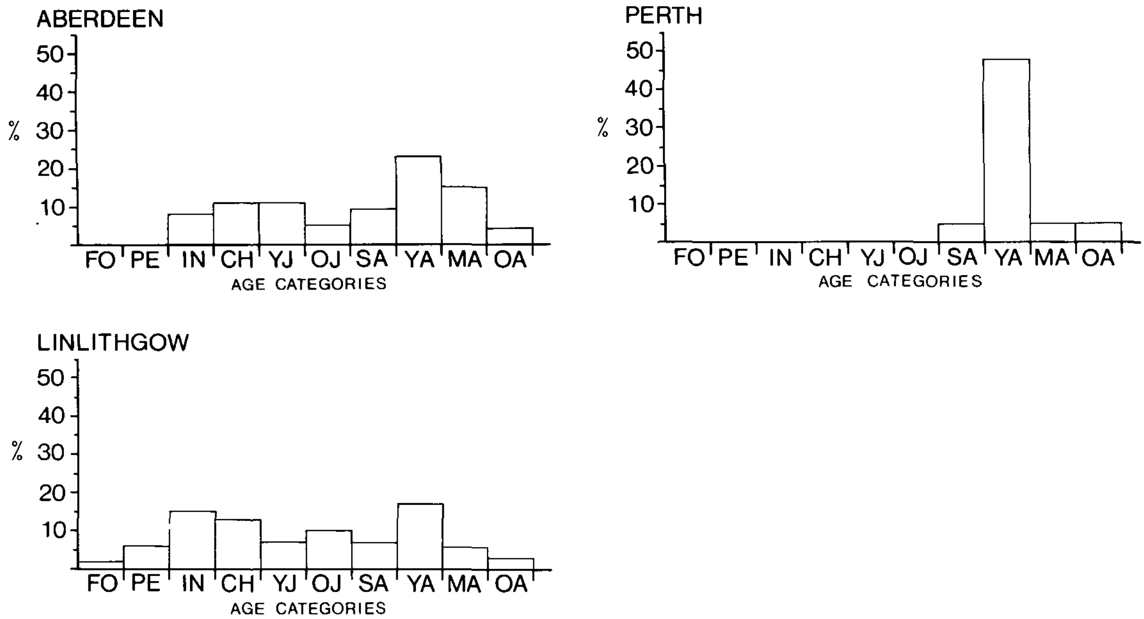
Sexually dimorphic features in the skeleton are not fully developed till puberty. For this reason sex determination from immature skeletons is not considered reliable and was not attempted in this study. Standard non-metric criteria were used to estimate sex from the pelvis and skull of adult skeletons (Brothwell 1981; Krogman 1978; Stewart 1979; Williams and Warwick 1980). The female pelvis is adapted for childbearing and is thus proportionally more capacious than in the male (Ill 59). However males are generally larger in overall body size and this is reflected in the skull which characteristically is larger and more robust with more pronounced muscle markings and bony ridges and processes (Ill 60). When there was a discrepancy between pelvic-based and cranial-based sex estimates, the pelvic estimate was used. Where pelvic evidence (or cranial evidence in the absence of pelvic evidence) was equivocal, sex was not assigned. Sex could not be reliably determined for a substantial number of adult SK burials (27% Aberdeen, 40% Linlithgow, 38% Perth).

The sex ratio in the Aberdeen series (34 males to 22 females) was strikingly different from that in Linlithgow (18 males to 31 females). In Perth the ratio was 7 males to 6 females. The differences are most probably accounted for by the sampling bias introduced by the incomplete excavation of the Aberdeen site and the disproportionately large number of female burials from the pre-friary chapel in Linlithgow (see Chapters 5.2, 7.2mf, 1: B12-D5).

AGE AND SEX DISTRIBUTION

The age by sex distribution of the SK burials for each site is shown in Ill 61. Those individuals in the general category of Adult have not been included. Some two-thirds of Aberdeen females did not live beyond young adulthood while male deaths were more evenly spread through the young and middle-aged categories. Deaths for both males and females peaked in young adulthood in the Linlithgow sample although a reasonable number survived to old age in the Perth series. Most of the individuals for whom it was possible to estimate sex died young.

These results suggest that generally, most of the women died while still relatively young and that more men survived to reach an advanced age. The difference between the sexes may be related in part at least to the risks of pregnancy and related obstetric problems.



ILL 58 : Age distribution of SK burials from each site, excluding the two broad age categories of Immature and Adult

ILL 59 : Adult male and female pelves. The female pelvis (right) although smaller in size, is proportionally broader than the male

NON-METRIC TRAITS

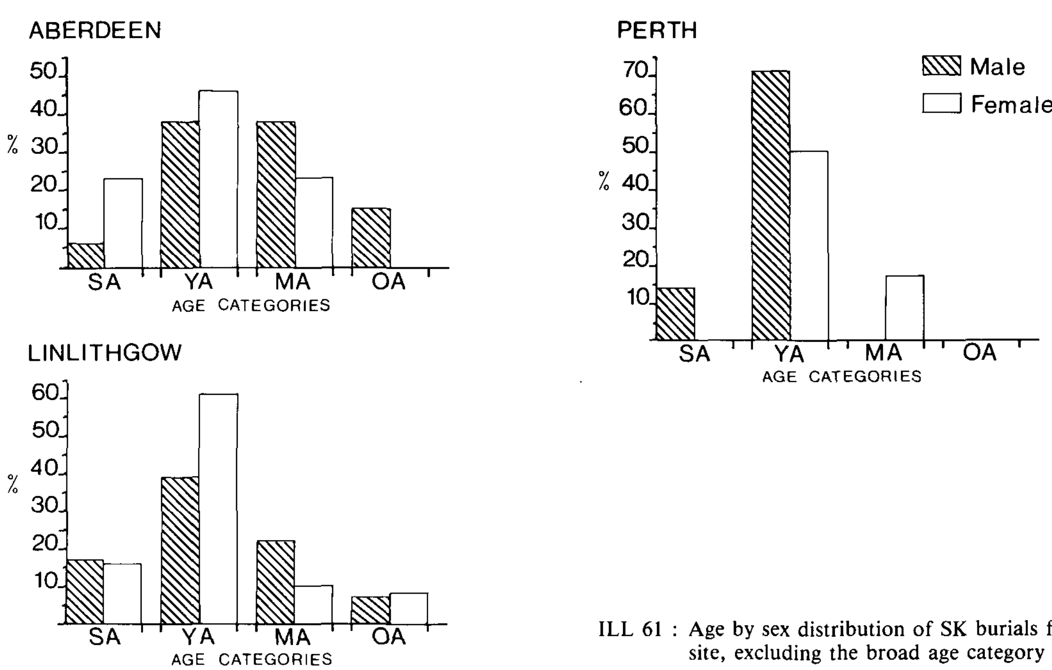
CRANIAL NON-METRIC TRAITS

The biological significance of variation in the incidence of cranial non-metric traits is not clearly understood although some relationship between the incidence of the non-metric traits and race, age and sex has been demonstrated (Brothwell 1959; Carpenter 1976; Corruccini 1974).

The incidence of selected cranial non-metric traits for each site has been listed in the microfiche (Tables 34mf, 5: D1-4; 46mf, 10: F7-10; 57mf, 11: F3-5). All available material, from both SK burials and disarticulated bones, was used. Immature and adult (18 + years) data have been listed separately. Meaningful statistical comparison of the incidence of the recorded non-metric traits was not possible due to the small sample size in each site.

The incidence of metopism and wormian ossicles may be indicators of childhood stress and as such is discussed below in the section concerned with health status.

ILL 60 : Adult male and female skulls. The male skull (left) is more robust than the female, with prominent brow-ridges



ILL 61 : Age by sex distribution of SK burials from each site, excluding the broad age category of Adult

POST-CRANIAL NON-METRIC TRAITS

The occurrence of post-cranial traits was noted and recorded on the individual SK skeleton sheets (Chapters 7.7mf, 2: A3-5:D6; 7.10mf, 5: F1-10: F12; 7.11mf, 10: G1-11: F6).

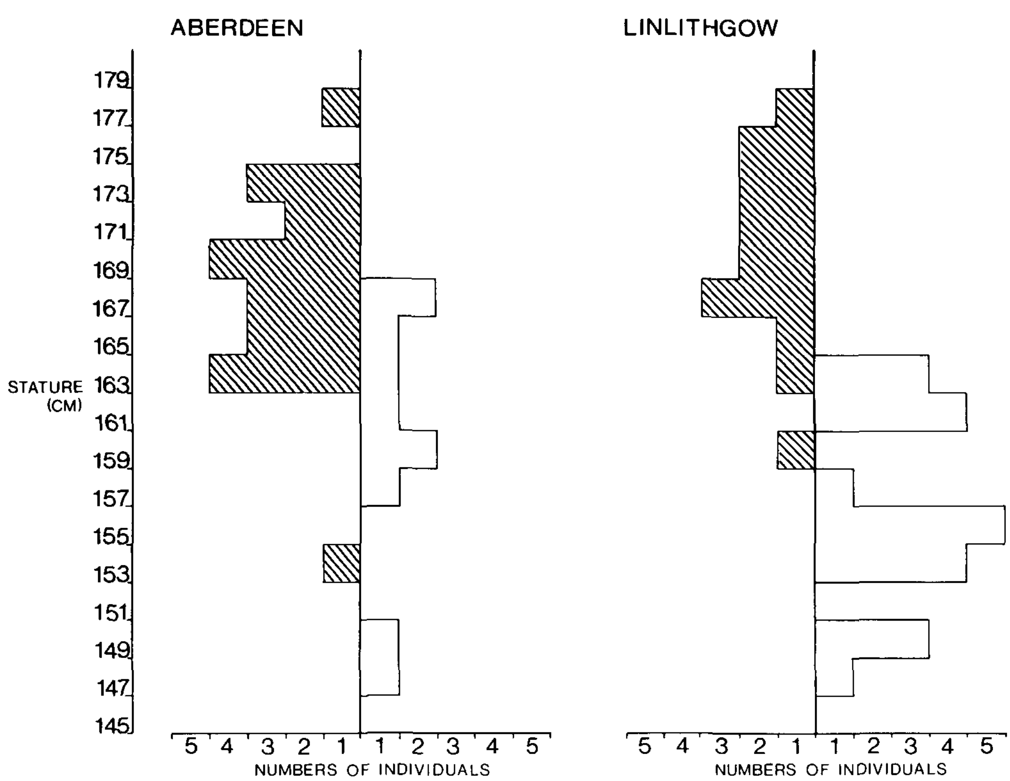
BODY BUILD

STATURE

Stature estimates were derived using standard regression equations based on the length of the long bones from the upper and lower limbs (Trotter 1970). Where more than one long bone was available, the regression equation with the lowest standard error of estimate was used.

The distribution of stature of males and females from Aberdeen and Linlithgow respectively is shown in Ill 62. In the Perth collection, it was possible to estimate the stature of only one individual, an adult male some 170 cm (5ft 7in) tall. In Aberdeen, the average height was 168 cm (5ft 6in) in males and 160 cm (5ft 3in) in females, while in Linlithgow, the figures were 170 cm (5ft 7 in) and 156 cm (5ft 1in) respectively. These estimates are slightly below modern values (176 cm in males, 163 cm in females), but are similar to many contemporary and earlier British populations (Table 11).

Stature is generally considered to be influenced by environmental and/or genetic factors. The genetic component sets the limits of the potential growth of an individual, but its contribution to stature is difficult to assess. Growth may be retarded under adverse environmental conditions, such as chronic malnutrition or frequent episodes of disease. As a result, an individual may not achieve his full potential stature. The influence of environmental conditions can be shown by the drastic increase in stature over the last 40 years. According to a recent government report (Knight 1984), the stature of men and women in their sixties and seventies today is comparable with that of the historic collections. The younger generations, in their twenties and thirties, are on average 2-5 inches taller, most probably as a result of improved nutrition and health care.

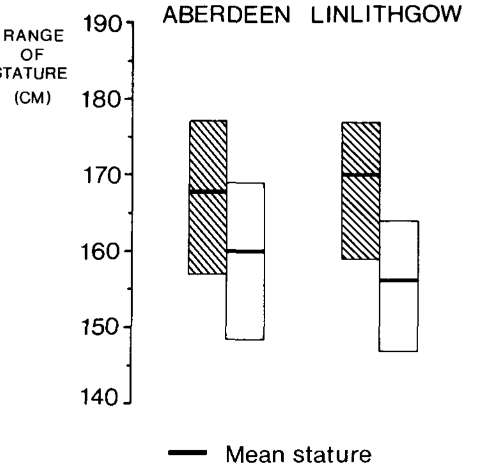


ILL 62 : Distribution of stature of SK burials (males on left) from Aberdeen and Linlithgow

Table 11 Mean stature (cm) of males and females in a series of British skeletal collections. Stature in feet and inches in parenthesis.

Date	Region	MALE cm	FEMALE cm	Source
Bronze Age	Britain	176 (5'9")	—	Manchester 1983
	Scotland	171 (5'7")	160 (5'3")	Bruce 1986
Romano-	Cirencester	169 (5'6")	158 (5'2")	McWhirr et al 1982
British	York	169 (5'6")	157 (5'1")	Dawes and Magilton 1980
Anglo-Saxon	London	164 (5'4")	156 (5'1")	Zivanovich 1986
Medieval	Aberdeen	168 (5'6")	160 (5'3")	This study
	Britain	172 (5'7")	—	Manchester 1983
	Guildford	173 (5'8")	161 (5'3")	Poulton and Woods 1984
	Linlithgow	170 (5'6")	156 (5'1")	This study
	Perth	170 (5'6")	—	This study
Modern	Britain	177 (5'9")	163 (5'4")	Knight 1984

It is interesting to note that there was considerably more overlap in stature between the sexes in Aberdeen than in Linlithgow (Ill 63). While Linlithgow females were shorter than their Aberdeen contemporaries, Linlithgow males were taller than Aberdeen males. Marked male/female differences in stature have been interpreted as indicating differential access to food resources and general care, with boys being favoured over girls. It would be unwise, however, to draw such conclusions in this study because of the confounding effect of the sampling biases referred to earlier.



ILL 63 : Range of stature of SK burials (males on left) from Aberdeen and Linlithgow

HEAD SHAPE

Indices derived from a number of skull dimensions can provide an overall impression of the shape of the skull. A summary of head and face shape is given in Table 12. All available adult material in each collection was used. The quantitative data are listed in microfiche (Tables 33mf, 5: C13-14; 45mf, 10: F5-6; 56mf, 11: F1-2).

Skulls in Aberdeen tended to be lower but more rounded compared to Linlithgow. The face and its various components was also broader and lower. The small sample size in the Perth collection did not allow for a realistic comparison of head shape with the other two sites.

A more detailed comparison of head shape was made, using skulls of known sex, based on two of the more informative skull indices (Tables 13, 14). The cranial index is a measure of the relative proportions of skull length and skull breadth. It is conventionally divided into three classes: doliochocranic (long and narrow) mesocranic (medium) and brachycranic (round). Generally, female skulls are more brachycranic than male skulls, although some spread across the three classes is to be expected. This appears to be the case in Linlithgow (Table 13). In Aberdeen, two out of fourteen skulls fell in the doliochocranic class while, interestingly, the pattern of distribution showed less variation in the male skulls. They all tended to be somewhat round-headed.

The cranial height index is a measure of the relative proportions of skull height and breadth. A skull may be tapeinocranial (low), metriocranial (medium) or akrocranial (high). Aberdeen skulls, both male and female, were found to be low while Linlithgow skulls tended to be somewhat higher (Table 14).

These results are broadly within the ranges of other British populations both historical (Dawes and Magilton 1980; McWhirr et al 1982) and modern (Goose 1981; Tocher 1921).

A trend from doliochocrany towards increasing brachycrany has been reported in European populations (Bielicki 1975; Goose 1981) over a time span from the Neolithic to the Medieval period. There is some suggestion of a reversal of this trend from around the 17th century onward in Scotland (Cross and Bruce 1983) but the significance of such small fluctuations during the course of history has yet to be established.

Skull shape may be affected by genetic and/or environmental factors and is of course related to a number of different functional complexes including the brain, jaws and teeth and overall body size (Moss 1958; Moss and Young 1960). It is therefore difficult to interpret the significance of relatively minor differences between populations.

Table 12 Description of skull and face shape, using all available adult material, for each site.

	ABERDEEN	LINLITHGOW	PERTH
Skull shape	Round	Medium	Medium
Skull height	Low	Medium	Medium
Forehead breadth	Medium	Medium	Medium
Face breadth	Medium	Narrow, high	—
Orbit shape	Medium	High	Low
Nose shape	Narrow	Narrow	—
Palate shape	Broad	Broad	—

Table 13 Cranial index (100 × Biparietal Breadth/Skull Length) of males and females from Aberdeen and Linlithgow.

	ABERDEEN				LINLITHGOW			
	MALE		FEMALE		MALE		FEMALE	
CLASS	n	%	n	%	n	%	n	%
Doliochocranic	0	0	2	14	2	22	0	0
Mesocranic	11	46	7	50	4	44	9	69
Brachycranic	13	54	5	36	3	33	4	31
Total	24		14		9		13	

Table 14 Cranial height index (100 × Skull Height/Biparietal Breadth) of males and females from Aberdeen and Linlithgow.

	ABERDEEN				LINLITHGOW			
	MALE		FEMALE		MALE		FEMALE	
CLASS	n	%	n	%	n	%	n	%
Tapeinocranial	19	91	9	100	1	25	5	71
Metriocranial	2	10	0	0	1	25	0	0
Akrocranial	0	0	0	0	2	50	2	29
Total	21		9		4		7	

LOWER LIMB SHAPE

Two indices, meric and cnemic, are conventionally used to describe the shape of the upper part of the shaft of the femur and of the tibia respectively. The meric index is a measure of the degree of antero-posterior (front to back) flattening of the femoral shaft, while the cnemic index expresses the degree of medio-lateral (side to side) flattening of the tibia. The two conditions are not necessarily related.

Table 15 Distribution of meric index (100 × Antero-Posterior Diameter/Medio-Lateral Diameter) of all available adult femora from Aberdeen and Linlithgow.

	ABERDEEN		LINLITHGOW	
CLASS	n	%	n	%
Platymeric	46	64	68	69
Eurymeric	26	36	30	31
Total	72		98	

Table 16 Distribution of cnemic index (100 × Medio-Lateral Diameter/Antero-Posterior Diameter) of all available adult tibiae from Aberdeen and Linlithgow.

	ABERDEEN		LINLITHGOW	
CLASS	n	%	n	%
Platycnemic	8	10	6	6
Mesocnemic	25	30	32	33
Eurycnemic	50	60	60	61
Total	83		98	

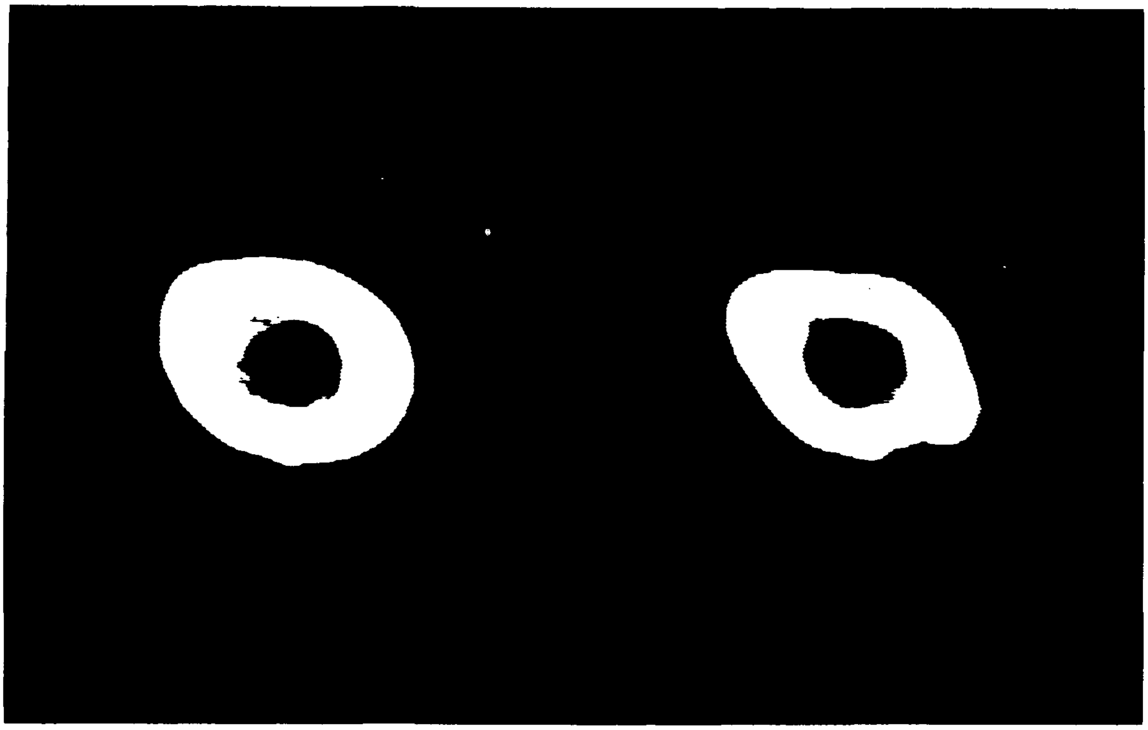
All available adult (18+ years) material from Aberdeen and from Linlithgow was used (Tables 15, 16). There was no significant difference between left and right sides so the material was combined. The Perth lower limb indices have not been included due to the small sample sizes (Tables 33mf, 5:C13-14; 45mf, 10:F5-6; 56mf, 11:F1-2).

Ill 64 shows a cross section of a eurymeric and of a platymeric femur, in the form of a CAT scan (Computed Axial Tomography, a form of X-ray). The greatest proportion of Aberdeen and of Linlithgow femoral shafts was found to be platymeric, ie they showed a marked degree of flattening from front to back (Table 15).

In the course of this study, it was observed that in the Aberdeen femora, the antero-posterior flattening was largely due to the presence of a projection, or flange, of bone on the lateral (outer) side of the shaft, giving rise to the oval shaped shaft. Absence of a distinct flange and of a marked degree of flattening results in the more cylindrical shape of a eurymeric femur.

The oval shape of a platycnemic tibia is shown in Ill 65. On this occasion, the shaft is flattened from side to side. Most tibiae in Aberdeen and in Linlithgow were found to be eurycnemic (Table 16).

Both platymeria and platycnemia are said to occur more frequently in prehistoric, historic and pre-industrialised groups of man (Brothwell 1981; Lovejoy et al 1976; Ruff and Hayes 1983). Various suggestions have been proposed to explain the biological significance of the variation in lower limb shape. These include: the presence of a pathological condition (Bass 1987), a physiological response to nutritional deficiency (Buxton 1938), or a biomechanical adaptation in response to particular patterns of loading on the bony shaft (Lovejoy et al 1976).



ILL 64 : CAT scans of adult left femora. Platymeric (right) shows marked flattening from front (top) to back; a distinct flange is also visible on the right-hand side of the shaft

ILL 65 : CAT scans of adult tibiae. Platycnemic tibia (right) shows marked degree of flattening from side to side

It has been suggested that in cases of mineral deficiency, an oval shaped shaft required less bone building material than a cylindrical one (Buxton 1938). However, in a comparison of platycnemic and eurycnemic tibiae, Lovejoy et al (1976) found that there was no significant difference in the amount of bone present, although there was a significant difference in the distribution of cortical bone around the medullary (marrow) cavity. In platycnemic tibiae, more bone is differentially deposited at the front and back of the shaft, giving rise to thickened areas. Bone is more evenly distributed in eurycnemic tibiae (Ill 65).

Selective deposition of bone may occur as a biomechanical response to applied external stress, eg muscle pull or body weight, in order to provide the maximum resistance against bone failure (Chamay and Tschantz 1972). In recent work on the biomechanical properties of tibial shaft shape (Lovejoy et al 1976; Ruff and Hayes 1983) it was concluded that an oval (platycnemic) tibia is adapted to withstand a significant amount of antero-posterior bending stress, which may arise while walking over rough terrain or from habitually squatting. If the tibia is not subjected to a significant degree of antero-posterior bending stress, it does not develop the platycnemic condition, remaining eurycnemic.

Further investigation of the Aberdeen femora, using computerised mathematical models (finite element analysis), suggested the lateral flange acts as a form of buttressing. This strengthens the femoral shaft in the area where maximum stress, due to body weight and muscle pull, is applied in normal walking (Lee 1984).

HEALTH STATUS

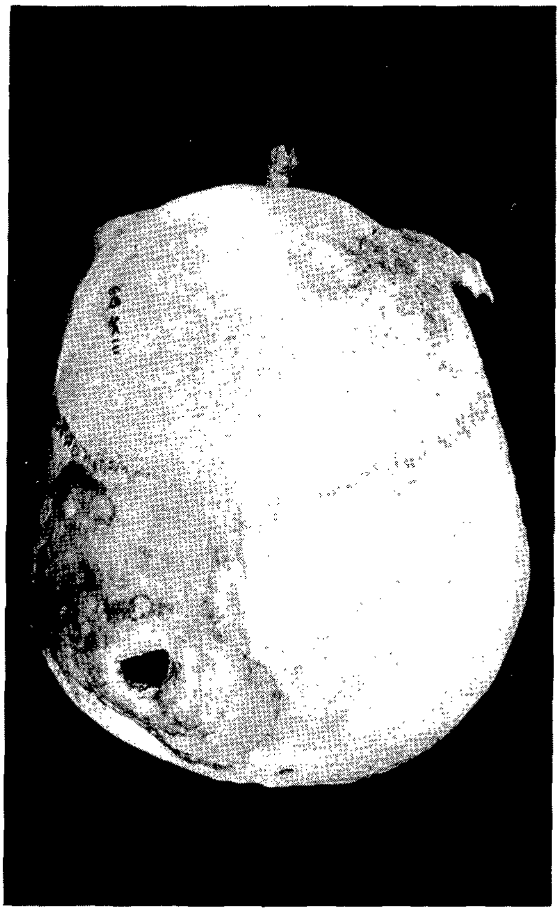
State of health and the ability to cope with disease and injury are significant factors in determining life-style. Skeletal evidence offers probably the most direct and the most reliable evidence of the health status and the disease burden borne by past populations.

The implications of the high infant and child mortality and of relatively short stature in the populations sampled have already been discussed. Before describing the pathology observed (here interpreted as any process, disease, anomaly or abnormality which affected bones or teeth during the lifetime of an individual) the limitations and constraints of the evidence available should be considered. The personal identity (name, occupation, year of birth, year of death, place of birth, place of death, life-history or cause of death) was not known for any of the individuals represented. The difficulties of reconstructing biological identities (sex, age-at-death, stature, body build) have been referred to earlier. Only the mineralised tissues of the body were available for study. Many skeletons were incomplete and many bones disarticulated and/or fragmentary. Very many diseases and injuries leave no trace on the skeleton. Most acute infections will either be resolved or will result in death before the skeletal tissues are affected. In the case of infections it is the inflammatory response of the bone tissue which causes changes in bone structure which can then be identified. It is frequently not possible to specify the micro-organisms (bacteria or viruses) responsible and the pathological changes are generally attributed to non-specific infections and the terms osteitis and/or periostitis applied to the bone lesion(s). In the case of some infections such as leprosy, tuberculosis and syphilis, the type and the pattern of distribution of the lesions is fairly characteristic and diagnoses of these diseases can often be made with some degree of confidence. However absence of evidence of leprosy for example need not imply that the disease was not prevalent in the general population. Lepers were often isolated in life—indeed there is evidence of a leper hospital in Aberdeen in the 14th century (Stones 1987, 22)—and may well have been buried outwith the general burial grounds. Moreover the facial skeleton and the small bones of the hands and feet where the disease typically manifests itself are often poorly preserved, as was the case in all three Carmelite skeletal series. Tuberculosis affects the skeleton in only some seven per cent of afflicted individuals (Steinbock 1976). Thus, although very few cases were identified in the three sites, the prevalence of the disease was probably considerably higher in the population at large.

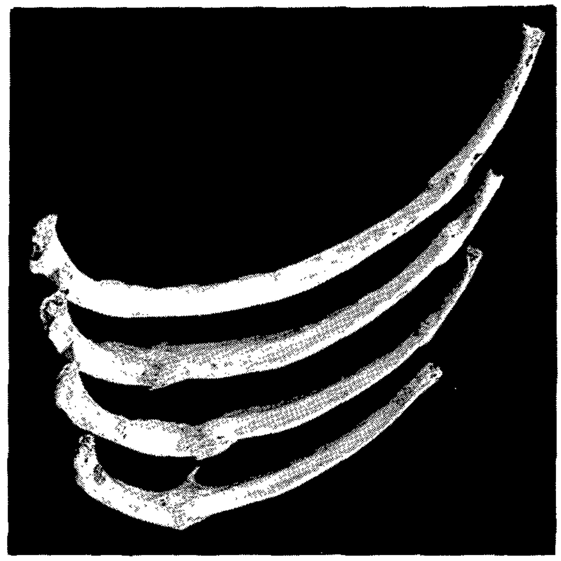
Some diseases show sex, age or occupation predilection so that comparisons among sites must take account of the sex and age profiles of the samples being compared. This is particularly so when comparisons are made with present day populations. Such comparisons may highlight interesting differences in age or site predilection as for instance is described below for dental caries.

The pathology observed in the three skeletal series is described below and the SK burials exhibiting particular pathological conditions are listed in microfiche (Tables 35mf, 5:D5-6; 47mf, 10:F11-12; 58mf, 11:F6).

FRACTURES



ILL 66 : Evidence of healed fracture on the left side of an adult skull SK 111 from Aberdeen



ILL 67 : Multiple healed rib fractures in Aberdeen SK 38

Of the SK burials, at least 11 individuals in the Aberdeen series, 13 in the Linlithgow and 2 in the Perth series had sustained fractures some time before death. In addition several disarticulated bones from each of the sites showed evidence of having been fractured. Most bones had healed well with good bony union and generally good alignment. There was little evidence of infection at the fracture sites, suggesting that most fractures were of the closed type (where the overlying skin remains intact). Fractures were more common in males (five males, one female in Aberdeen; four males, one female in Linlithgow; one male in Perth). Fractures of the left side of the skull were seen in three adult males from Aberdeen (SK 41,76,111) and one adult male from Linlithgow (SK 26) (Ill 66). In an adult of unknown sex from Linlithgow (SK 158) the skull injury was nearer the midline. The left side of the skull is the most common site for blows to the head from a right-handed assailant. Several cases of fractured ribs were seen in Aberdeen (SK 38,84,112, and three disarticulated ribs) and Linlithgow (SK 35,183). In SK 38, a middle-aged male, four ribs were involved, two of which had been broken both at the front and back, suggesting a crush type of injury (Ill 67). The fibula was the most commonly fractured bone in both the Aberdeen and the Linlithgow series. This is hardly surprising in view of its exposed position on the outer border of the leg. The left fibula of SK 115 from Linlithgow had healed with poor alignment of the two fragments. In SK 83 and SK 98 from Linlithgow the fractures were at the upper end of the bone and were probably the result of a direct blow or force. Most fibular fractures at the lower or ankle end are caused by falls or by tripping over objects. In the Aberdeen male SK 38 the injury had involved the tibia as well as the fibula and led to subsequent bony ankylosis (fusion) of the two bones of the ankle. Less than perfect alignment following union of the broken shaft segments was evident in a disarticulated femur (Aberdeen) (Ill 68). This type of injury is commonly caused by falling from a height. This may also have been the cause of the only fractured, but well-healed, tibia seen in the Aberdeen series (disarticulated specimen). Interestingly, at least two tibial fractures were seen in the small Perth series. In SK 8, an external burial, the right tibial midshaft break had united soundly but with marked lateral bowing of the shaft. This individual had also fractured the lower end of his right ulna, possibly in the same accident. The tibial fracture in SK 12, an internal burial, was at the lower level and had healed well. There may be a third case of tibial fracture from Perth where the sound but "swollen" appearance of the left tibia of SK 4 may have been the result of an earlier fracture. Associated with SK 4 was a disarticulated fibula which also shows evidence of a healed fracture. There is however some difficulty in interpreting the injuries in SK 4 since there was also a third tibia found in association with this specimen. This fragment of the lower third of the shaft was grossly enlarged with bone deposition suggestive of osteomyelitis. In SK 17, another internal burial, the protruberance on the outer border of the upper shaft of the left femur may also have resulted from a fracture. Thus as many as four individuals (SK 4,12,17, disarticulated fibula) in the Perth "internal" burial group of eleven may have sustained lower limb fractures. Other lower limb fractures included a possible case of a healed greenstick fracture of the tibial shaft in the Linlithgow female SK 150; a healed midshaft fracture of the fifth metatarsal (SK 112, Linlithgow) and a fractured but malaligned fibula with involvement of the tibia (SK 173, Linlithgow). Two possible cases of fractures involving the pelvis were noted. In SK 3 (Aberdeen) the bone

ILL 68 : The femur on the right shows a well-healed fracture of the upper shaft (normal femur on the left)

at the pelvic attachment of the powerful kicking muscle, rectus femoris, has been avulsed but subsequently reunited. In SK 72 (Linlithgow) there may have been a fracture dislocation of the left side of the pelvis with subsequent therapeutic reduction followed by good union.

Fractures of the upper limb were somewhat less common than in the lower limb at all three sites. In Aberdeen three examples of forearm fractures were noted—in SK 16 (right ulna), SK 112 (left ulna) and in a disarticulated radius. SK 112 had also a fractured right rib and it may have been that the ulna was injured when the forearm was raised to protect the head, thus diverting the blow to the chest wall. SK 122 had sustained a fracture to the surgical neck of the humerus while a disarticulated matched right scapula and humerus showed very extensive degenerative change and deformity which may have been secondary to a fracture of the humerus, although differential diagnosis must include septic arthritis. The left ulna of SK 115 (Linlithgow) had been fractured in the upper shaft with good union but poor alignment. The elbow region of a matched but disarticulated radius and humerus showed marked deformities of both bones suggestive of earlier fracture. Unfortunately the corresponding ulna was not present. SK 8 (Perth) had fractured the lower end of the right ulna as well as of the right tibia. No case of fractured clavicles was observed from any site. Two individuals from Linlithgow had fractured bones in the hand. In the case of SK 162 the site of injury was the thumb metacarpal while in SK 182, the bone involved was the fifth left metacarpal. This latter fracture may have been the result of a misdirected punch.

At least five individuals had sustained more than one fracture—Aberdeen: SK 38, ribs, tibia and fibula; SK 112, rib and ulna. Linlithgow: SK 26, skull and ulna, SK 158, skull and fibula. Perth: SK 8, ulna and tibia. It is likely that SK 158 had suffered a dislocated left shoulder in addition to his skull and leg injuries.

It should be noted that fractures occurring just before or at the time of death are very difficult to differentiate from the effects of post-mortem damage to bones.

OTHER EVIDENCE OF TRAUMA

While fractures are commonly the result of a single traumatic incident, degenerative joint disease (DJD) can be considered to be more of a "wear and tear" phenomenon, often resulting from repeated episodes of micro-traumata or as a long-term consequence of an earlier incident. Not surprisingly the pattern and extent of DJD is usually strongly correlated with age and with life-style.

In all three skeletal series, the spine was the region of the skeleton most affected by DJD. Two quite different types of joint occur in the spine. In the first type the main weight-bearing sections of adjacent individual vertebrae are united by a strong fibrous disc, which is turgid in the young as a result of its gelatinous internal consistency. The second type of joint (facet joint) is found between the arches of adjacent vertebrae and is similar in structure to the joints found in the limbs, where the surfaces of the bones are covered with low friction cartilage, separated by a viscous film of lubricant and enclosed in a fibrous capsule. The pattern and onset of DJD may differ in the two types of joint. DJD was more widespread in the disc joints than in the facet joints in all three sites and was evident to some degree in virtually all adult spines and even those of some subadults. This confirms Jeffreys' comment (1980, 14) that 'the body begins to degenerate as soon as it stops growing. Nowhere is this process more apparent than in the spine; as though Nature were exacting retribution for our presumption in standing on our feet'. Disc joint DJD was particularly evident in the middle cervical, middle thoracic and lower lumbar regions. The most frequently affected site was the disc space between the fifth and sixth cervical vertebrae. In the majority of cases the degeneration was relatively minor in degree and only isolated examples severe enough to involve fusion of adjacent vertebrae were seen (eg in SK 112, Aberdeen). DJD of the disc joints is often considered to be a consequence of disc degeneration.

DJD of the facet joints occurred most frequently in the upper thoracic and lumbar regions. The sites most affected were the upper facets of the fifth thoracic vertebra and the lower facets of the second lumbar vertebra. Facet joint DJD was also evident in some subadult spines.

Both forms of DJD were somewhat more common on the right-hand side of the spine. The pattern of degeneration on the spine was broadly similar in all three sites.

The early onset of both forms of DJD, its frequency and the pattern of its distribution suggest that the majority of the individuals represented in these three series were used to fairly strenuous physical labour.

DJD was also seen in the joints of the limbs with the Linlithgow series showing more widespread DJD than the Aberdeen series. Overall, the bones most frequently affected were those of the wrist joint and base of the thumb which suggests occupational factors. (Aberdeen SK 10,38,47,59,

ILL 69 : Shoulder joint (scapula and humerus) showing severe destruction of the joint surfaces with virtual loss of the humeral head and eburnation on both joint surfaces

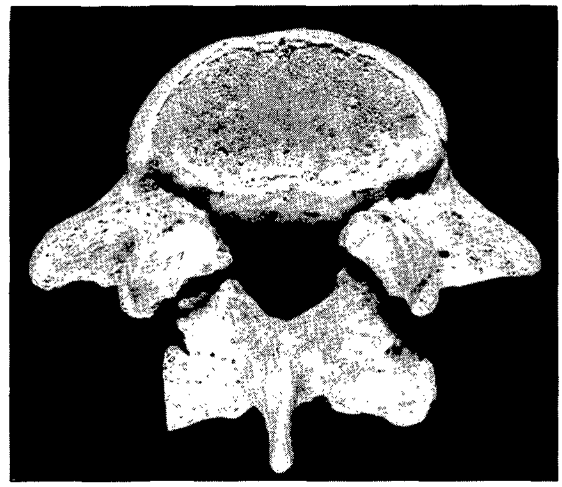
106,122: Linlithgow SK 98,108,175,181). DJD also tended to be more severe in the wrist, leading to complete destruction of the protective cartilage and eburnation (polishing) of the exposed bone surfaces in most of the specimens noted above.

There was little evidence of significant DJD in the hip, shoulder or knee joints in the Aberdeen skeletons (with the exception of the matched disarticulated scapula and humerus noted above) (Ill 69). Hip, shoulder and knee joint involvement was more apparent at Linlithgow (SK 83,108, 150,158,164,181). Some individuals showed DJD at several joints (eg SK 38 from Aberdeen with both wrists, finger and ankle joints affected and SK 108 from Linlithgow with degenerative change in shoulder, wrist, finger, hip, knee and sacro-iliac joints). In the Perth series severe DJD with eburnation was seen in a disarticulated left femur and to a lesser degree on the bases of three metatarsals in SK 6, and on the lower (elbow) joint surface of the humerus in SK 16.

The extent of degenerative change in one or several joints is the basis of many methods used to determine age-at-death in adult skeletal remains. Unless adequate information is available about life-style factors, great care must be exercised in interpreting and comparing age profiles derived from such estimates, which are nevertheless often the only ones available or even possible.

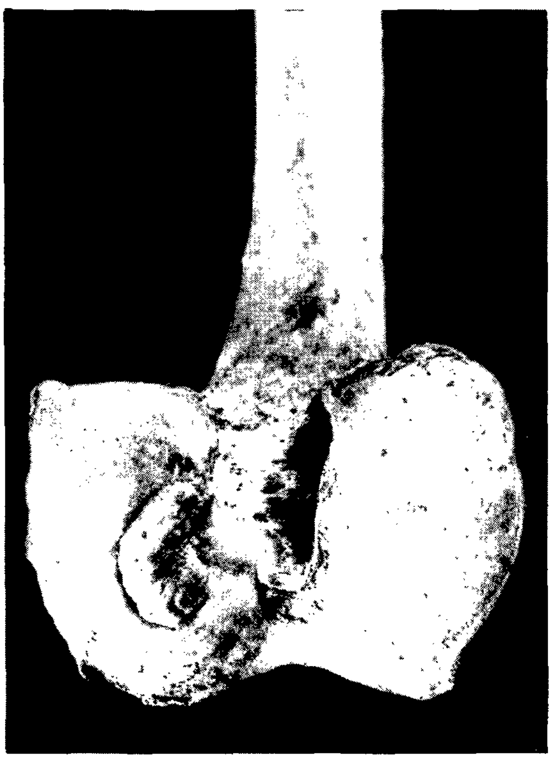
A number of other conditions may also be trauma-related. These include Schmorl's nodes, lesions of the spine generally considered to result from herniation or escape of material from an intervertebral disc into the bone surface above and/or below the disc, resulting in a pit or depression on the dried bone surface. They occur characteristically towards the back of the central area of the vertebral body surface. Developmental factors and/or heavy compressive loading of the spine in adolescence have been implicated. Schmorl's nodes were common in all three sites. In Aberdeen, females showed an unusually high incidence (67%) comparable to that seen in males (70%) in whom the condition is generally more common as was the case in Linlithgow where only two identifiable females (SK 32 and SK 185) were affected of the seventeen SK burials with these lesions. Evidence of these disc herniations was also seen in at least two individuals (SK 8, SK 16) from the small Perth series. The nodes were frequently multiple, involving several disc spaces and were particularly common in the lower thoracic and upper lumbar regions. In most cases nodes were found on at least 25% of vertebral body surfaces below the eighth thoracic vertebrae. In Aberdeen males the thoracic spine was more affected than the lumbar spine while in females the nodes were fairly evenly distributed (Saluja *et al* 1986). This difference in distribution between the sexes may have resulted from anatomical/developmental differences or from different patterns of stress and loading of the spine and requires further investigation.

The high incidence and severity rates reinforce the argument that many of the population were used to hard physical tasks from an early age.



ILL 70 : Fifth lumbar vertebra showing detached rear portion of the neural arch—spondylolysis

Spondylolysis is another type of spinal lesion which has been associated with trauma although it probably has a developmental or genetic basis. In this condition the posterior (rear) arch of a vertebra is separated from the body of the vertebra on one or both sides (Ill 70). It most commonly involves the fifth lumbar vertebra. In the Aberdeen sample, some 8% of fifth lumbar vertebrae were affected, bilaterally in each case. This incidence is a little higher than in recent European populations and a little higher than at Linlithgow where two cases of fifth lumbar spondylolysis were seen (SK 27,176), both lesions were unilateral. Interestingly, two individuals in Linlithgow had separated vertebral arches at the more unusual sites of the second thoracic vertebra (SK 58) and the atlas vertebra (SK 32). Spondylolysis may remain symptom-less throughout life but in some cases the detached vertebral body portion may slip forward and, in some females, can cause obstetric problems. It is difficult to detect evidence of this forward slipping in skeletal remains. However in the female SK 12 (Aberdeen) the spondylolysis was associated with severe degenerative change on the lower surface of the fifth lumbar vertebra and upper surface of the sacrum suggesting that forward slipping may have occurred in this case.



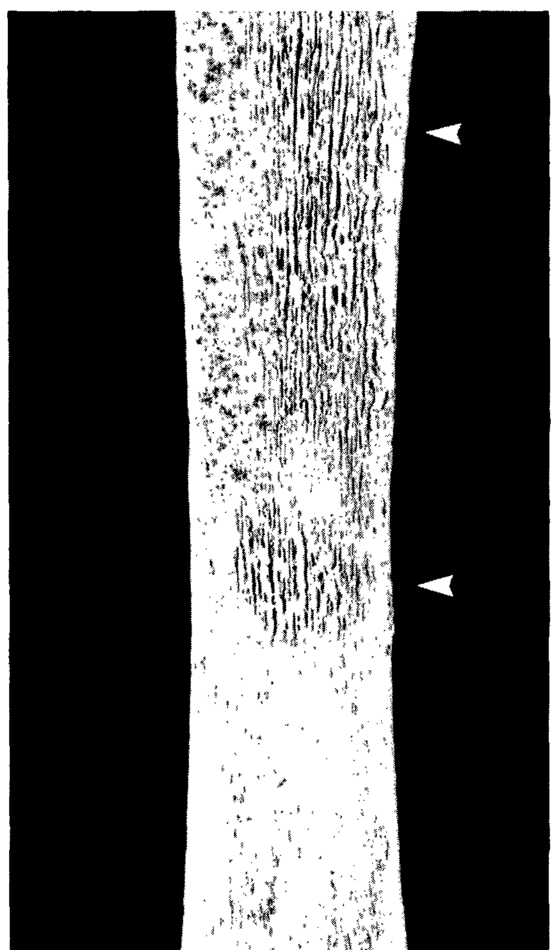
ILL 71 : Irregular raised island of bone on the knee joint surface of the femur—osteochondritis dissecans

The presence of defects or, in some cases, of irregular protruberances on the articular (joint) surfaces of limb bones may be the result of osteochondritis dissecans. This is thought to result from interruption of blood supply with the subsequent degeneration and resorption of a small area of cartilage and/or underlying bone leading to a defect on the dried bone surface. In the example illustrated (Ill 71), the raised area of bone may have resulted from an overgrowth of bone filling in the defect on the distal (knee joint) surface of the femur. This particular specimen (SK 101) was the only likely example of the condition identified in the Aberdeen series. By contrast, at least nine cases were seen in Linlithgow (SK 27,35,84,98,134,148,174,185,188). The condition was bilateral in at least four individuals, affecting the humerus at the elbow joint, the femur at the knee joint and the base of the first metatarsal in two individuals. Other sites included the talus at the subtalar joint, the tibia at the knee joint, the ulna at the elbow joint and the base of the second metacarpal.

Trauma has been invoked as a factor in this lesion which generally starts between the ages of 12 and 18 years.

The flattening of the head of the femur seen in two Aberdeen specimens (SK 91 and a disarticulated bone) and in a disarticulated specimen from Perth may have resulted from avascular necrosis (death of bone tissue as a result of interruption of its blood supply). Trauma may also be implicated in this condition.

Evidence of injury to muscle, tendon or ligaments may be found at the sites of their attachment to bones. Disturbance of the contour and texture of the bone was relatively common at the site of attachment on the clavicle of the ligament binding the clavicle to the first rib. This ligament is made taut when the arm is raised above the head and when it is brought forward as in powerful pushing movements. Similar lesions were relatively common at the attachment sites of the ligament binding the tibia and fibula just above the ankle joint. Walking over uneven surfaces would put particular stress on this ligament. Disturbance of the contour and texture



ILL 72 : Signs of inflammatory change—periostitis—on the tibial shaft of the bone at the humeral site of attachment of the muscle pectoralis major (a powerful muscle used in chopping and in climbing actions) were relatively common in Aberdeen, Linlithgow and Perth, especially in males. Other similar lesions were seen at the site of attachment of the biceps muscle on the radius, at the humeral attachment of the deltoid and at the tibial attachment of the powerful invertor of the foot (tibialis posterior), at the tibial attachment of the extensor of the knee joint (quadriceps femoris), at the patellar attachment of the part of that muscle which prevents medial displacement of the patella, at the tibial attachment of the calf muscle, soleus, and on the femoral attachment of the adductor muscles, which help to control gait and posture at the hip joint.

Some localised patches of surface inflammatory change on bone (osteitis/periostitis) may have initially involved injury to the overlying soft tissues. Such patches were frequently seen on the tibiae and fibulae of children and adults in all three series (Ill 72). Trauma, however, is unlikely to have accounted for all such cases. Wells (1982) has pointed out that osteitis/periostitis in the tibia and fibula appears to have been relatively common in earlier populations but appears to have no parallel in modern clinical practice and its cause(s) is as yet unexplained.

CHILDHOOD MORTALITY AND MORBIDITY

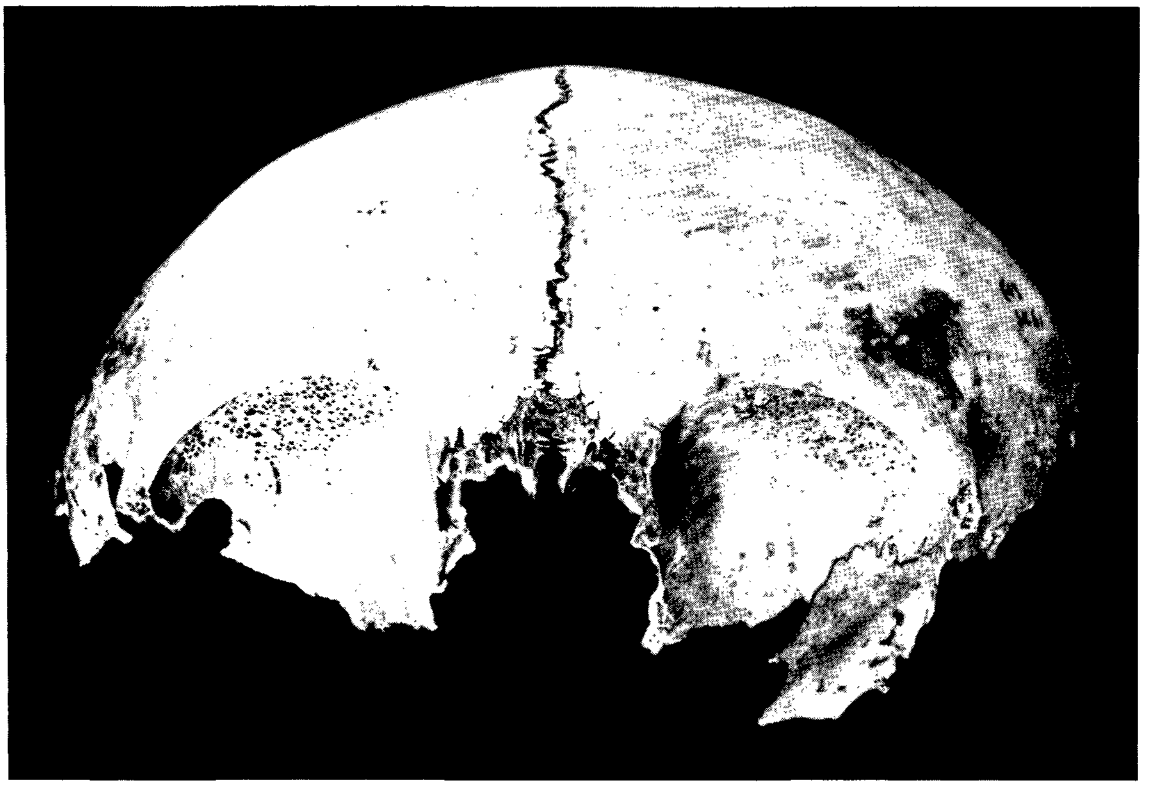
A number of skeletal features have been regarded as "markers of metabolic insult"—that is they provide evidence of periods of stress during the period of growth of the skeleton and teeth. Childhood illness or nutritional, psychological or metabolic stress may interrupt or disturb the normal rate and pattern of growth leaving permanent or at least reasonably long-term evidence of this disruption.

On the teeth, disturbance in the development of the enamel of the crowns of the teeth can result in macroscopic defects, known as enamel hypoplasia. Since enamel is not remodelled after it forms, these defects can be detected in adult teeth. Furthermore since the formation of enamel follows a well-recognised timetable it is possible to estimate when the defect occurred. Defects in tooth enamel were common in Aberdeen and Linlithgow with just over half of the individuals studied showing moderate to severe hypoplasia (Kerr 1987). The Perth sample was too small to allow reliable comparisons. Defects had occurred from the second through the fourth year of life with rather fewer growth defects occurring in the first year. In modern populations the peak period of enamel disruption is the first year of life. However the pattern observed in this study is in line with that reported by Swärdsted (1966) in a mediaeval Swedish sample and with Wells (1968) in a 17th to 18th-century English sample. Wells considered that diseases likely to produce enamel defects were also likely to have been fatal during the first year and so no record was left in the form of a defect. The majority of defects occurred after the age of about eighteen months. This is probably linked to two main factors—the loss of protection afforded by maternal antibodies in milk on weaning and the increased exposure to health hazards as the child became more independently mobile. There was some evidence of a trend for those individuals with most hypoplasia to die before young adulthood was reached. Dental attrition was quite marked in both series and so it is likely that the amount of enamel hypoplasia was underestimated since some of the evidence would quite literally have been worn away as the teeth were worn down.

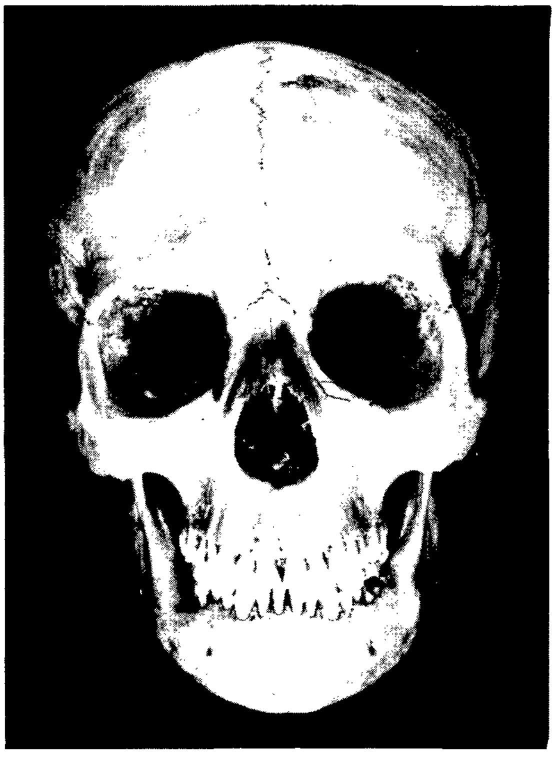
Disturbance of the growth of long bones can be linked to the presence of dense transverse plates of bone (Harris lines or lines of arrested growth) visible radiographically or when a bone has been damaged, so exposing the fine trabecular bone of the interior (Ill 73). Harris lines were common as can be seen from the incidence in the tibiae of at least 16 children in Aberdeen as well as in adults (18 of 23 SK individuals). Males and females were about equally affected.

The frequency of enamel hypoplasia and Harris lines suggests that childhood was punctuated by periods of stress sufficient to interfere with normal growth. The nature of the stress cannot be specified, however, since a number of different factors produce the same type of growth disturbance.

ILL 73 : Radiograph of an adult tibia to show Harris lines—fine white lines passing horizontally across the shaft



ILL 74 : Frontal bone of a child's skull showing fine pitting—cribra orbitalia—on the roof of the eye-sockets



ILL 75 : Adult skull showing persistent metopic suture between the two halves of the frontal bone

Cribra orbitalia is a lesion which is considered to be indicative of a more specific condition. It is manifested by pitting of the bone on the roof of the orbits (eye-sockets) and may be part of a more generalised lesion (porotic hyperostosis) (Ill 74). It is most usually associated with iron-deficiency anaemia. Until recently it was considered that cribra orbitalia was caused by anaemia present shortly before death or current at the time of death. Stuart-Macadam (1985) has challenged this view, suggesting that cribra orbitalia in adult skeletons is related to childhood anaemia, probably incurred before the age of 5 years. Severe anaemia in childhood was probably incompatible with life. Parasitic infection, unhygienic living conditions, weaning problems, prolonged lactation as well as diets deficient in iron are contributory factors in the aetiology of iron-deficiency anaemia.

In the Aberdeen series mild cribra orbitalia was seen in at least eight children and adolescents but no adult cases were identified. More than twenty cases were noted in Linlithgow. These included at least ten adults of whom seven were female. Eight of the ten children who were affected were aged about five years or less. Interestingly, no cribra orbitalia was observed in the large Linlithgow Period 2 Phase 4 group of infants and children. No evidence of cribra orbitalia was found in the Perth series.

Metopism (the persistence of the suture between the two halves of the frontal bone of the skull) has been said to be associated with iron-deficiency anaemia (Riemann 1978) although genetic and other factors have also been invoked (Ill 75). About 10% of European populations can be expected to show this trait. The incidence at Linlithgow—21 cases of 95 frontal bones present—was markedly higher. Of these 21 individuals, 18 were buried in the cloister, the chancel or the nave; of the eight skulls where sex could be identified seven were female. All four of the disarticulated skulls found in

Period 2 Phase 5 had metopic sutures. Some previous workers have suggested familial relationships where clusters of the trait occur (Zivanovic 1986, 253). However the factors underlying the delayed or non-closure of this suture have not yet been clearly established. Until they are, it would be unwise to infer relationships, either familial or through common pathology among these individuals. The incidence of metopic sutures was lower in Aberdeen (8 individuals; 3 females, 5 males) and Perth (2 individuals).

Other anomalies of skull suture closure commonly seen in skulls from all three sites were wormian ossicles, individual small islands of bone found along the lambdoid suture at the back of the skull (Ill 76). Inca bones, separate ossicles in the normally single occipital bone, were noted in no fewer than five specimens in Aberdeen, one in Linlithgow and none in Perth. Interestingly, another type of anomaly in skull growth was relatively frequent in Aberdeen. In these cases the part of the skull corresponding approximately to the region of an Inca bone, projected to give a 'bun' or 'chignon' appearance in profile (Ill 77). This has been linked to a period of rapid catch-up growth of this part of the skull and of the underlying occipital region of the brain (Trinkhaus and Le May 1982). 'Buns' were more common in Aberdeen (n = 25) than in Linlithgow (n = 5) or Perth (n = 1).

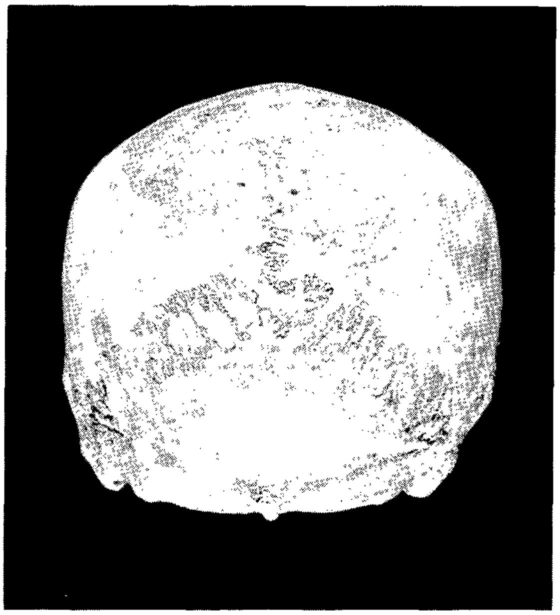
There were relatively few other indications of developmental anomalies. Most of those observed occurred in the vertebral column, particularly in the lumbo-sacral region. Sacralisation of the last lumbar vertebra, lumbarisation of the first sacral segment and sacra with an additional segment were the most common vertebral anomalies. Their pattern and incidence were broadly similar in the larger samples, Aberdeen and Linlithgow, and similar to that reported in present day European populations. Additional vertebrae were identified in three individuals (Aberdeen SK 84 with thirteen thoracic vertebra; Linlithgow SK 70 with six lumbar vertebrae, Linlithgow SK 181 with apparently thirteen thoracic and six lumbar vertebrae). Anomalies of vertebral shape were seen in the slight twisting or scoliosis of the sacrum in SK 3 and in the forward convexity of the sacrum of SK 5, both from Aberdeen as well as in sharp forward angulation of the sacrum in SK 70 from Linlithgow. The lower thoracic region in Linlithgow SK 40 showed a slight scoliosis with reduced vertebral body height on the left side. The fusion of cervical vertebrae 5-7 in Aberdeen SK 76 may have been congenital. No instance of reduction in vertebral number was found but partial fusion between adjacent vertebrae was seen between the arches of the first and second lumbar vertebrae and of the fifth lumbar and first sacral vertebrae in Aberdeen SK 26. These fused elements do not appear to be part of the pathological process involving other regions of this spine.

Examples of developmental anomalies in the rest of the skeleton included non-fusion of the hook of the hamate (a small bone of the hand) in Aberdeen SK 12, of the tip of the acromion process of the scapula in Aberdeen SK 71 and Linlithgow SK 53, of the tuberosity of the fifth metatarsal of the foot in Linlithgow SK 39 and of additional ossicles in the acetabulum of the innominate bone in two Linlithgow specimens and one case of bilateral cervical ribs (SK 35, Linlithgow). It is possible that the non-union of bones in SK 12,71,53,39 was traumatic in origin.

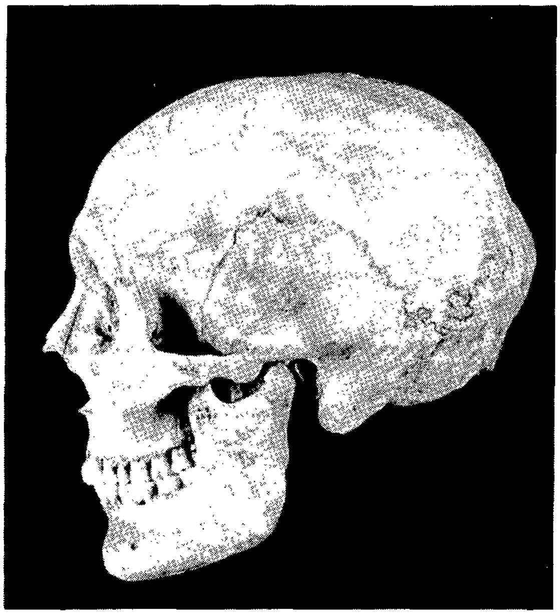
The incidence of non-fusion of the rear elements of the sacrum across the midline (sacral spina bifida occulta) was low in all three collections as it is still today in the East of Scotland. This could tentatively be interpreted to suggest the long-term operation of factors associated with low susceptibility to this condition which in the mild form observed in skeletal remains may be asymptomatic but which in the more severe form may be fatal. Only one case of spina bifida above the level of the sacrum was found—in the atlas vertebra of Aberdeen SK 93.

Generally neither the incidence nor the severity of congenital or developmental anomalies of the skeleton was particularly remarkable in any of the three series.

Relatively small sample sizes, fragmentary remains and conmingling or dissociation of skeletal elements combined with biological factors such as differences in the severity and timing of onset and completion and/or degree of permanence of childhood stress indicators and congenital anomalies preclude drawing firm conclusions about the association between these features and age-at-death or adult stature.



ILL 76 : View of the skull from behind to show small islands of bone known as wormian ossicles along the lambdoid suture



ILL 77 : A projection or 'bun' at the rear of the skull interrupts its otherwise continuous smooth curve

METABOLIC DISEASE

A number of metabolic diseases leave evidence on the skeleton. No unequivocal evidence of rickets was seen in any of the three sites. One child from Aberdeen (SK 28) did show some bowing of the limbs but this was not marked. The presence of scurvy could not be inferred with any confidence although some of the periostitis/osteitis of the limb bones referred to earlier may be associated with scurvy. Scurvy has also been implicated in cribra orbitalia (see above). Osteoporosis (a reduction in the amount of mineralised bone tissue per unit of bone volume) particularly affects the vertebral column where it may lead to weakened vertebrae which become compressed or wedged. Several cases of collapsed or wedged vertebrae were seen in Aberdeen, Linlithgow and Perth but there was not sufficient evidence to link these with clinical osteoporosis, which has a strongly age-dependent incidence.

Iron-deficiency anaemia of childhood, as evidenced by cribra orbitalia, appears to have been relatively common, particularly in Linlithgow. Given the multiplicity of factors which are linked to iron-deficiency anaemia (see above) it is difficult to isolate the factors responsible for the site difference.

NEOPLASMS (TUMOURS)

There was little evidence of any form of neoplasm in any site and no unequivocal evidence of malignant disease. In Aberdeen one adult male (SK 40) had two small button-like growths or osteomata on his skull. Two cases may be tentatively diagnosed as osteochondroma (bony excrescence capped by cartilage) in a matched disarticulated tibia and fibula from Aberdeen and on the midshaft of the radius of Linlithgow SK 199. A small bony mass was present in the frontal sinus of Linlithgow SK 2 and a similar mass was seen in the depression on the humerus above the elbow joint (the olecranon fossa) in a disarticulated specimen. An area of bone erosion on a disarticulated mandible from Aberdeen may have been associated with a neoplasm.

INFECTIOUS DISEASE

The inflammatory lesions of periostitis/osteitis seen on many tibiae or fibulae have been referred to earlier. However inflammatory change was noted in a number of other bones. The area round the external ear opening was affected in three individuals from Aberdeen (SK 46,64 and 79) and in one (SK 17) from Perth. Other affected areas on the skull included the inner surface of the temporal bone (Linlithgow SK 180), the sphenoid (Linlithgow SK 192), the base of the skull (Aberdeen SK 36), the floor of the maxillary sinus in Perth SK 13, the palate and sinuses of the child Linlithgow SK 62, around the margins of the nasal cavity in Linlithgow SK 26. Similar lesions were widespread in several individuals, for example in the elderly adult Aberdeen SK 92 where almost all the long bones and the pelvis were affected, in the subadult Linlithgow SK 184 where most of the limb bones were involved and the Linlithgow teenager SK 177 where the right humerus, clavicle and scapula and the supra-orbital ridges of the skull showed areas of inflammatory reaction. Other locations affected included the area round the joint between the first and second segments of the sternum (Perth SK 16), on the shaft of a disarticulated radius from Aberdeen, on the mandibles of Linlithgow SK 91,149,183 and 188 and on the sixth to tenth thoracic vertebrae in Aberdeen SK 100.

The more extensive lesion of osteomyelitis which involves the interior as well as the surface of a bone, was seen in the lower left fibula of the middle-aged adult Linlithgow SK 66 (Ill 78), the right clavicle of Linlithgow SK 189 and the disarticulated tibia found associated with Perth SK 4.

The grossly pathological spine of the Aberdeen child SK 26 is very suggestive of tuberculosis (Ill 79). Lesions in the spines of SK 100 and SK 122 may also be tuberculous. There was less convincing evidence from Linlithgow and none from Perth. The appearance of the inner surfaces of the ribs of the young adult SK 150 and the vertebrae of SK 70 and SK 94 from Linlithgow may possibly also be the result of tuberculosis.

No clear evidence of leprous involvement was found in any of the skeletal material from any site. The nasal lesions in Linlithgow SK 26 cannot be positively identified as leprous.

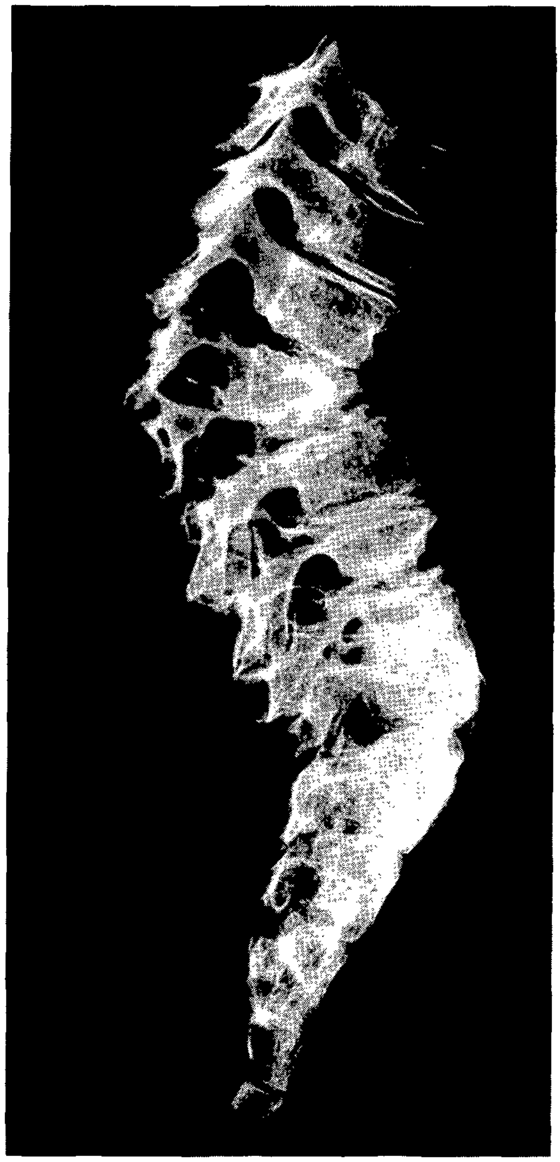
Organisms known as treponemes are responsible for venereal and non-venereal forms of syphilis. In Scotland the latter was known as sibbens (Steinbock 1976). No unequivocal evidence of treponemal infection was found in any of the three sites although the diffuse expansion and inflammatory pitting of the right tibia and fibula in SK 112 from Linlithgow and the tibia found in association with SK 4 from Perth may have been due to some form of treponemal infection. It may be that sibbens did not become widespread until more crowded and more unhygienic conditions prevailed in these burghs.

MISCELLANEOUS LESIONS

In many instances it was not possible to determine the underlying cause(s) of skeletal lesions.

In a child from Aberdeen (SK 86) there was evidence of a generalised growth disorder in which there was a failure in the process of remodelling the shafts of the long bones (metaphysial dysplasia) as well as a series of punched out lesions on the vertebral bodies. Differential diagnoses include an inherited dysplasia, Gaucher's disease or even chronic lead

ILL 78 : Osteomyelitis in a fibula: normal bone is seen in the upper part of the section



ILL 79 : Radiograph of the spine of Aberdeen SK 26 showing destruction and collapse of the vertebral bodies

poisoning. A disarticulated mandible from Aberdeen shows marked asymmetry of both dental wear and periodontal disease which may have been the result of a long-standing facial palsy. In Aberdeen SK 72, marked pathological change on the opposing surfaces of the disc space below the last lumbar vertebra suggests a large cystic lesion which was probably not malignant in view of the well-formed bone surfaces. A condition known as hypercementosis affected the teeth of Aberdeen SK 100, in which there was also gross inflammatory destruction, possibly tuberculous, of several thoracic vertebral bodies. In Aberdeen SK 47, the left humerus and ulna were markedly shorter than the bones of the right side. An interesting complex of lesions was seen in the hand of the Linlithgow adult SK 33, in which there were destructive lesions on the bones of the thumb (metacarpal and phalanges) accompanied by bony fusion across its terminal joint. The differential diagnosis includes chronic infection of the finger tip, trauma followed by infection, possibly in a thumb rendered insensitive due to nerve injury or disease or to untreated infection of the nail area. Thickening of the diploë (the marrow spaces in the bones of the vault of the skull) was seen in Aberdeen SK 68 and in Linlithgow SK 32 (a young adult) and SK 164 (a middle-aged female). Notching of the incisors was seen in Aberdeen SK 51, Linlithgow SK 6 (1 young female) and in SK 70 (a young adult). This condition is sometimes seen in cases of congenital syphilis but the evidence is too slight to invoke this diagnosis. In Linlithgow SK 66 a defect in the bone of the mandible may have been the result of an odontogenic cyst or fibrous dysplasia. Premature closure of the joint (synchondrosis) between bones of the base of the skull (the basi-sphenoid and basi-occipital) appears to have occurred in the Linlithgow juvenile SK 69. Closure normally occurs between 18-25 years of age but the appearance of the rest of the skeleton suggests a considerably younger age. The bones of both lower limbs, including the innominate bone, were distorted (with antero-posterior bowing and medio-lateral flattening) in the Linlithgow juvenile SK 86.

ORAL HEALTH

A detailed study based on the most intact jaws and teeth available in the two larger series of skeletons revealed some intriguing differences between the Aberdeen (Kerr 1986; Kerr *et al*, forthcoming) and Linlithgow (Kerr, pers comm) study groups in the extent and pattern of dental decay (caries). While just over half (56%) of the individuals in the Linlithgow sample had caries, less than one third (29%) of individuals in Aberdeen were affected (Ill 80). In both groups caries were more common in adults than in juveniles, in marked contrast to the present day caries prevalence rates in Scotland (Todd and Whitworth 1972). The number of carious teeth, expressed as a percentage of teeth present, was some 5% in Aberdeen and almost 8% in Linlithgow. In Aberdeen the teeth most frequently affected were the second and third molar teeth. Some 12% of all second and third molars present were carious and about 7% of all first molars and second premolars and only 2% of first premolars were affected. No caries were detected in incisor (front) or canine (eye) teeth in Aberdeen dentitions. In Linlithgow the teeth most often attacked by caries were the first molars (18%) followed by the second and third molars (12%), the second premolars (9%), first premolars (6%), canines (3%), central incisors (2%) and second incisors (1%).

Caries prevalence, age distribution and location of attack in the Aberdeen study was broadly similar to the results obtained by Lunt (1972,1974,1986) in the only other studies of Scottish material of approximately comparable date. The number of individuals with carious teeth in Linlithgow was similar to that reported (50%) by Olsson and Sagne (1976) in a Swedish medieval population. The percentage of carious teeth in both Aberdeen (5%) and Linlithgow (8%) was lower than that reported by Tattersall (1968) in an English medieval sample (11%). However the pattern of tooth involvement in Linlithgow and in Tattersall's group was similar in that the tooth most frequently affected was the first molar.

In both sites the number of cavities was greater than the number of teeth observed, that is, many teeth had multiple lesions. Many of the individuals with caries had more than one carious cavity eg in Linlithgow some 60% of caries was found in 27% of affected individuals. Differences in caries prevalence between, and within, groups may result from a number of factors. Some individuals have a genetically based increased susceptibility to caries. Some individuals may have had preferential access to high sugar—and cariogenic—diets. Coarse diets may offer some protection from caries attack by removing stagnant plaque especially from the areas between the teeth. Differences in milling practice may therefore influence caries prevalence rates. Cultural differences in oral hygiene practices may similarly either offer some protection from or conversely increase the likelihood of caries attack.

Dental attrition was markedly more severe than seen today, no doubt reflecting the much coarser diets in historic times. Attrition was seen even in deciduous teeth and by the late twenties the teeth of many individuals were so worn that the internal sensitive pulp chamber was exposed to the environment of the mouth and apical abscesses frequently followed (Ill 81). Teeth appeared to have continued to erupt in adulthood in an attempt to maintain facial height to compensate for the loss of tooth height by surface attrition (Kerr 1987). This resulted in exposure of the roots of the teeth. In some of the cases where this was observed the condition of the crest of bone between the teeth was relatively healthy, which suggests that periodontal disease was not the only factor leading to increased root exposure.

Few adults in any of the sites were free from some degree of periodontal (gum) disease which was most common and most severe in the molar region of the mouth. Calculus deposits, heavy at times, were seen in many teeth (Ill 81).

ILL 80 : Mandible showing large carious cavities on the molar teeth

ILL 81 : Adult skull showing evidence of an abscess around the roots of the upper left first molar. The teeth show heavy uneven wear on their biting surfaces and moderately heavy calculus deposits

This suggests that cleaning of the teeth was not part of a regular oral hygiene routine for many people.

Tooth loss was marked by the fourth decade. Some 4% of all teeth had been lost during life in the Aberdeen study group, with the greatest loss in the older age groups (9%). In Linlithgow ante-mortem tooth loss was more than twice as great (9%), due in part at least to the higher caries prevalence in Linlithgow.

No cases of impacted wisdom teeth were identified in Aberdeen but these third molars were absent in some 20% of individuals. It appears that the amount of attrition of the tooth surfaces was sufficient to allow those wisdom teeth which were present to erupt and to become functional. Two cases of impacted upper canine teeth and one case of congenital absence of both lower second molars were noted in Aberdeen. A supernumerary tooth was present in the palate (in the incisive fossa) in an Aberdeen skull. No congenital defects such as cleft palate or other facial anomalies and no fractured jaws were identified in the Aberdeen series. Degenerative joint disease of the jaw, albeit relatively minor, was observed in five specimens. A possible case of a cyst on the palate (nasopalatine) was noted. The uneven wear on some teeth suggests they may have been used for purposes other than chewing. Enamel hypoplasia was common (see above). There was no evidence of therapeutic dental intervention in any of the Aberdeen jaws although no doubt tooth extraction at least was practised.

The dental analysis of the Linlithgow group is continuing. Jaws and teeth are unfortunately relatively poorly represented in the Perth series.

ILL 82 : SK 19 from Linlithgow, a young woman who may have died in a fire

CAUSE OF DEATH

In no case was it possible to establish the direct cause of death. Doubtless many deaths were due to acute infections, bacterial or viral, and to organic disease which left no evidence on the skeleton.

The prone burial position associated with flexed upper limbs and spine seen in SK 19 from Linlithgow (Ill 82) merits further comment. In death resulting from fire, muscle protein coagulates and the muscles assume a contracted position, pulling limbs and spine into a flexed position. Unlike *rigor mortis,* this contraction does not pass. It would be difficult to inter such a body in the normal position—indeed it could probably only be laid down in a prone position. Thus it is possible that this young woman from Linlithgow met her death in a fire. Other less likely explanations include hasty burial while the body was still in *rigor mortis* or following death from hypothermia.

7.6 THE SKELETAL REMAINS: DESCRIPTION OF MICROFICHE CONTENTS JF CROSS

In microfiche 1 : E5 - G3

7.7 ABERDEEN 12 MARTINS LANE: SKELETON RECORD SHEETS AND TABLES JF CROSS

In microfiche 2 : A3 - 5 : D6

7.8 ABERDEEN HADDEN STREET: SKELETON RECORD SHEETS AND TABLES JF CROSS

In microfiche 5 : D7 - E3

7.9 ABERDEEN RADIOCARBON DETERMINATIONS

In microfiche 5 : E4

7.10 LINLITHGOW:
SKELETON RECORD SHEETS AND TABLES
JF CROSS

In microfiche 5 : F1 - 10 : F12

7.11 PERTH:
SKELETON RECORD SHEETS AND TABLES
JF CROSS

In microfiche 10 : G1 - 11 : F6