Belts or clothing

89 Belt or fragment of clothing. Length 145mm; width 60mm; thickness 1.5mm. Approximately rectangular fragment, with three oversewn edges, fourth edge torn. Traces of very fine stitching near torn edge, possibly for attachment of buckle. Worn, not delaminated. (Not illustrated). Context 591; Phase 2

Miscellanea

90 Circular dished fragment. Diameter approximately 130mm; thickness 6mm. Approximately circular dished fragment, grain side uppermost. Two parallel rows of grain-flesh slits, possibly stitching, stitch length 7–8mm (outer), 6–7mm (inner), approximately 4.5mm apart; outer one is 5mm from edge of object. Iron nail? in one stitch hole. Approximately circular iron stain on underside/flesh side; part of this stain resembles shape of frog on underside of horse's hoof. Two tears, one large and one small. Cattlehide. Protective pad for horse's hoof? (Illus 65). Context 588; Phase 2

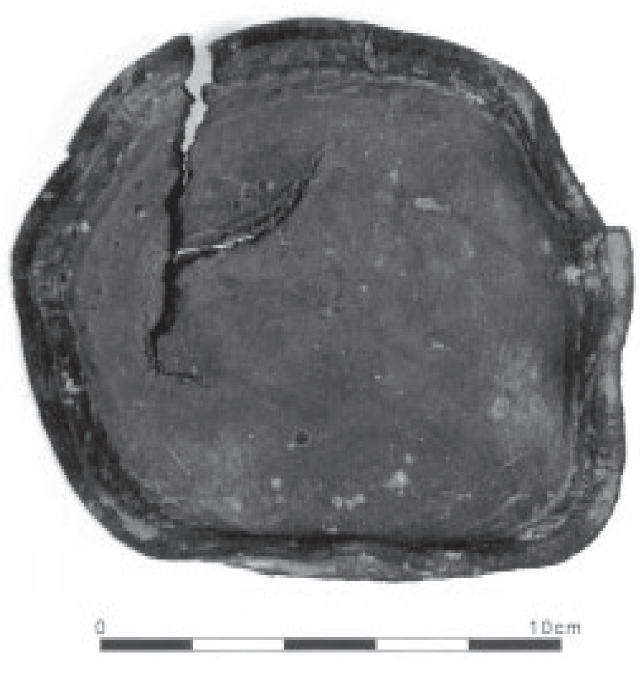
91 Decorated strip. Length 168mm; width 24–30mm; thickness 2mm. Strip of leather, now in two pieces, with three irregularly cut edges, fourth torn. Small irregularly shaped hole in join between the two fragments; this is either a strap hole or a result of wear. Decorated with one broad shallow groove, 3x19mm, engraved with a blunt tool, and a repeated pattern of triangles, marked by very thin lines incised by a pointed tool. Worn and partially delaminated. Cattlehide. Possibly part of an unfinished strap or sheath. (Not illustrated). Context 500; Phase 3

92 Tiny seat shaped piece. Length 48mm; width at waist 20 mm; maximum width 49mm. Tiny seat shaped piece, all edges cut. Four small stitch or nail holes, one on edge, approximately 8mm from waist; the others form a line across fragment, approximately 15mm from waist. Delaminated, only flesh layer survives. Remnant from infant's shoe? Small pad? (Not illustrated). Unstratified, from machine cut trench.

93 Fastening. Length 90mm; width 68mm; thickness 2mm. Irregularly shaped fragment with possible latchet with oval cut-out tab and single hole. All edges cut. (Not illustrated). Context 1050; Phase 2

94–6 Fragments with rivet holes? Three fragments, one rectangular, the others irregular, with holes which may have been made by rivets. (Not illustrated). Context 1050; Phase 2

97 Fragment with rivet. Irregularly shaped folded fragment with rivet holding two thicknesses together; very fragmentary. (Not illustrated). Context 1315; Phase 4



Illus 65 *Circular dished fragment; Context 588, unphased.*

The lithic assemblage

Torben Bjarke Ballin

Introduction

The definitions of the main lithic categories are as follows:

Chips All flakes and indeterminate pieces the greatest dimension (GD) of which is not more than 10mm.
Flakes All lithic artefacts with one identifiable ventral (positive or convex) surface, and whose GD is over 10mm and length is less than twice its width.
Indeterminate pieces Lithic artefacts which cannot be unequivocally identified as either flakes or cores. Generally the problem of identification is due to irregular breaks, frost-shattering or fire-crazing.
Chunks are larger indeterminate pieces, and in, for example, the case of quartz, the problem of identification usually originates from a piece flaking along natural planes of weakness rather than flaking in the usual conchoidal way.
Blades and microblades Flakes where length is equal to or greater than twice its width. In the case of blades, width over 8mm, in the case of microblades W not more than 8mm.
Cores Artefacts with only dorsal (negative or concave) surfaces—if three or more flakes have been detached, the piece is a core, if fewer than three flakes have been detached, the piece is a split or flaked pebble.
A *core fragment* is defined as a fragment of a core which could not be classified more precisely: if it is possible to determine that the fragment of a core is the fragment of, for example, a single-platform core, the artefact is classified as such.
Tools Artefacts with secondary retouch (modification).

Description

Eight flint artefacts were recovered, all thought to be residual. They consisted of one single-platform core, one irregular core, one core-fragment, one hollow scraper, one end-scraper, one piercer, one flake and one flake fragment.

Raw material

The lithic artefacts are all in the same type of relatively coarse black-and-grey flint with acceptable flaking properties. Some pieces, however, are marred by impurities, reducing the use-value of this raw material (eg No 99). The cortex varies between fresh/powdery (Nos 101, 104, 105) and smoothly abraded/severely battered (the remainder). Hollow scraper No 100 is fire-crazed, and irregular core No 103 is patinated (corticated *sensu* Shepherd 1972). The parent nodules of the artefacts would have been large, in some cases exceeding a greatest dimension of 120mm (No 103).

The flint type, colour, size and fresh cortex define this raw material as exotic to Scotland, with the chalk region of south-eastern England being the most likely place of origin. When recovered in connection with Scottish coastal town and city excavations (eg Kenworthy 1982), it has routinely been dubbed 'ballast flint'. It has previously been retrieved from sites in Aberdeen (Kenworthy 1982; Saville 2001; Ballin forthcoming a) and Edinburgh (Finlayson 1997; Ballin forthcoming b). As demonstrated in Ballin (forthcoming a) and by the present assemblage, many of the pieces of so-called 'ballast flint' are actually debitage, cores or tools, and this type of dark flint most likely represents a so far unnoticed lithic industry of indeterminate date (see discussion, below).

Debitage

Only two pieces of unmodified debitage (Nos 101, 105) were recovered. Though missing its proximal end, No 101 is most likely the fragment of a platform flake, whereas No 105 is an intact bipolar flake.

Cores

The assemblage includes three cores: one single-platform core (No 99), one irregular core (No 103) and one core fragment (No 102). The single-platform core has a plain platform and a crudely trimmed platform-edge, and one side has been detached by frost action (weakened by impurities). The large irregular core is almost cubical, with two edges and one corner having been trimmed by coarse retouch or rubbing. No 102 is a small core-fragment with a plain platform and a crudely trimmed platform-edge; the edges and corners of this piece display use-wear, probably from scraping hard materials, such as wood, bone or antler. The presence of large, circular impact scars along the platform-edges, and on the various faces of the cores, demonstrate that all three pieces have been worked by the application of hard, direct percussion.

Tools

Three of the eight lithics from Horse Cross are tools: one is a piercer (No 98), one a hollow scraper (No 100), and one an atypical end-scraper (No 104); they are all simple, expedient pieces. The piercer is on a robust hard-hammer flake with a triangular outline, and it has been modified (shaped and blunted) by crude retouch or rubbing along all three edges. The tip is at a distal corner, and use-wear at the ventral face of the tip demonstrates how this tool was used by rotating it clockwise as well as anti-clockwise. The hollow scraper, which was made on a large bipolar core fragment, most likely has two working-parts: the slightly concave, surviving terminal of the piece may have been used for scraping/shaving, and the larger lateral notch was most definitely used for scraping hard materials. No 104 is an irregular and idiosyncratic piece, with a broad, thick handle-part and a narrow working-edge. It was formed on a large distal flake fragment, and it has some lateral blunting at the handle-end, with the scraper-edge being convex and steep. Like the cores described above, the three tools were made by the application of direct hard percussion, combined with coarse retouch or rubbing, and they appear to have been used for the processing of mainly hard materials, such as wood, bone or antler.

Technology

As part of the analysis of the assemblage from the Carmelite Friary in Aberdeen (Ballin forthcoming a), two technological profiles were defined, Profiles A and B. The former is mainly associated with the local, frequently orange beach flint, mainly reduced by the application of soft percussion; this sub-assemblage is assumed to be of an earlier prehistoric date (Mesolithic to Early Bronze Age). Profile B corresponds quite precisely to the present assemblage, in terms of applied technology as well as raw material preference, and is assumed to be of a considerably later age (the latest Bronze Age, Early Iron Age?). The only difference between the material from the Horse Cross site in Perth and Profile B from Aberdeen is that No 99 from the present collection indicates that, in some cases, flakes were produced from large, crudely trimmed platform cores, and not entirely from irregular and bipolar cores, as suggested in the report on the flints from the Carmelite Friary in Aberdeen.

Combined, the assemblages from Aberdeen and Perth represent a poorly controlled technology aiming at the production of robust flakes by the investment of as little effort as possible (an expedient approach). The raw material used is black-and-grey, relatively coarse chalk flint, most likely from the south-eastern part of England. The flakes were occasionally detached from simple single-platform cores with plain platforms and crudely trimmed platform-edges but, mostly, the cores were either irregular or bipolar. The platform and irregular cores were reduced by the application of direct hard percussion, frequently leaving large circular impact scars along platform-edges, or on the various faces of the cores. It is likely that bipolar technique was applied at either end of the operational schema (*chaine operatoire*), firstly to 'quarter' the original nodules to make the nodule sizes suitable for hand-held hard-hammer production, and secondly to exhaust the raw material of the platform and irregular cores when they became too small to handle.

Discussion

As noted in Ballin (forthcoming a), the most pressing questions regarding the above industry are its date and the provenance of the raw material.

No diagnostic types in black-and-grey flint were recovered during the excavations in Aberdeen, Perth and Edinburgh (ibid) but a number of technological attributes suggest a relatively late date: the fact that the aim of this industry was to produce flakes and not blades indicates a date of the Late Neolithic period or later (Pitts and Jacobi 1979); the complete lack of invasive retouch indicates a date after the Early Bronze Age (Clark 1936); and the absence of a coherent operational schema indicates a date at the transition between the Bronze and Iron Age periods or later, as even later Bronze Age assemblages were produced in an acceptably schematic manner (Ballin 2003).

The size of the parent nodules, and the fresh cortex of some of the artefacts, suggest a provenance in the part of Britain characterised by chalk flint, that is, the south-eastern shires of England. It is unlikely that flint was traded into Scotland merely to satisfy an expedient, probably declining, lithic industry. Consequently, it has been suggested (Ballin forthcoming a) that the black-and-grey chalk flint may actually be ballast flint, albeit late prehistoric ballast flint, used in the earliest boat types requiring ballast, and, secondarily, used as raw material by some of the last Scottish flint knappers? The latter suggestion tallies well with the late date indicated by the technological attributes of these assemblages.

98 Piercer, secondary hard-hammer flake. Length 43mm, width 43mm, thickness 20mm [abraded cortex]. The piece has an approximately triangular outline, and all three lateral and distal edges have been partially blunted by a combination of coarse retouch and crude rubbing. The left distal corner is acutely pointed, and the two adjoining edges have been crudely modified. The function as a piercer is further supported by flat ventral flake scars near this tip: one small flake was detached from either edge, ventral face, suggesting that the piece was rotated clockwise as well as anti-clockwise. (Not illustrated). Context 182; Phase 3

99 Fragment of corticated single-platform core. Length 37mm, width 36mm, thickness 33mm [abraded cortex]. Plain, natural platform surface with massive circular impact scars from the application of direct hard percussion; crude trimmed or 'rubbed' platform-edges. One side of the piece has been detached by frost. (Not illustrated). Context 350; Phase 2

100 Hollow scraper on corticated bipolar core-fragment. Length 43mm, width 38mm, thickness 22mm [abraded cortex] The piece has a crushed ridge at one end, which is probably a bipolar terminal, but it is almost certain that this slightly concave feature (chord 18mm, depth 2mm) was also used for scraping or shaving hard materials. The other terminal has broken off, and one corner appears to have been used for graving. In one lateral side, a large (chord 23mm) and deep (11mm) concavity has been formed by a combination of coarse retouch and subsequent scraping/shaving work on hard materials. (Not illustrated). Context 523; Phase 2

101 Distal/lateral fragment of unmodified secondary flake. Length 19mm, width 21mm, thickness 8mm [fresh, powdery cortex]. The piece has split longitudinally, and the right lateral side has broken off. (Not illustrated). Context 582; Phase 4

102 Corticated core-fragment with use-wear. Length 19mm, width 20mm, thickness 13mm [abraded cortex]. Side-fragment of indeterminate core type with a crudely trimmed platform-edge and a plain platform surface. Practically all edges show macroscopic use-wear, probably from scraping. (Not illustrated). Context 582; Phase 4

103 Irregular (multi-platform) corticated core, (patinated). Length 121mm, width 103mm, thickness 75mm [abraded cortex]. Four uncorticated faces have been created by deliberately detaching large flakes by blows to either edges or corners. Two edges and one corner have been trimmed by coarse retouch or rubbing. Large circular impact scars demonstrate how this core was reduced by the application of hard direct percussion. (Not illustrated). Context 754; Phase 5

104 End-scraper on distal fragment of large secondary flake. Length 97mm, width 54mm, thickness 49mm [relatively fresh cortex]. The piece is pointed with a broad, thick handle-end, which makes it very similar to heavy core piercers. However, the modification of the pointed end constitutes a narrow (c17mm), convex scraper-edge and not an acutely pointed piercer-tip. At the end of the handle furthest from the working-edge, one lateral side has been crudely blunted. The flat end of the handle and all other faces display several large circular impact scars (and one huge Hertzian cone), defining the technique applied to shape the piece as hard direct percussion. (Not illustrated). Context 905; Phase 4

105 Unmodified secondary bipolar flake. Length 35mm, width 19mm, thickness 9mm [fresh, powdery cortex]. (Not illustrated). Context 1211; Phase 2

Gaming piece

Mark Hall

A probable ivory object was found during borehole work during demolition of the former General Accident Print Works in November 2002. Initial examination by eye and microscope suggests that the material is skeletal, probably ivory. The high polish, texture and colour are typical of walrus ivory and the presence of dentine tissue confirms this—this is often exposed in walrus ivory and represents the pulp cavity of the walrus tooth.

The most likely identification of this object is as a gaming piece, possibly of Scandinavian origin. Similar pieces are known from a number of Scandinavian cultural contexts (eg Trondheim, Norway; Dublin, Ireland and Sandnaes, Greenland), mainly dated to the

Illus 66 *Ivory gaming piece; borehole.*

11th–12th centuries. Generally such pieces were used for the game of hnefatafl, a board game for two players, and widespread throughout the North Sea world. The hole in the base could be a lathe turning-hole but is more likely to represent a spiked hand-held tool on which the object was fixed whilst being finished. Such holes generally have a squared section because they were made by a square-sectioned spike (which had less movement than a round-sectioned spike). Such holes could also have been used to receive pegs or dowels of wood or metal so that the pieces could be used on a peg-board.

The recovery of the object from a borehole sample means that there is no stratigraphic context, which in turn means that it could come from either a medieval or post-medieval context. However, its identification as a gaming piece suggests that a medieval date is very likely, probably of the 11th to 14th centuries. There is other artefactual evidence from the early phases of the town to suggest the presence of Scandinavian merchants and craftsmen, and in 1266 the Treaty of Perth was con-cluded between Alexander III and envoys from King Magnus IV of Norway in the nearby Blackfriars Monastery, bringing an influx of Scandinavian visitors.

106 Ivory gaming piece Diameter 31.5mm, thickness 31.4mm, weight 24.94gms. Basal hole: diameter 4.1mm x 4.5mm, depth approx 13mm. It is piriform or pear-shaped and tapers to a point that may have been abraded in antiquity for, although uneven, it has the same polish as the rest of the surface. However, this could represent the natural condition of the raw material. The flat base of the object is pierced by a small hole, which has a squarish section. There are traces of a dirt-encrusted deposit on the flat base, and within the hole a greyish deposit that appears to be mostly soil but possibly may contain metallic decay products. (Illus 66). Borehole; unstratified.

The industrial waste

Ray Chadburn

Introduction

Finds initially described as metalworking debris (MWD) were catalogued into context groups and a morphological examination was carried out. The material was sorted and classified, with some groups individually weighed and described while other selected examples were removed for more detailed analysis. The morphological classification is derived from the following characteristics: size, shape, colour, density, vesiculation and magnetism. The three main groups of metal working debris consist of:

Diagnostic residues from primary metal production, which consist of smelting slag, tapped slag, and either natural or roasted metal ore. None of these were found and the indications are that the smelting of ferrous and non- ferrous metals was not carried out.

Non-ferrous and multi metalworking A small quantity of copper material was found that could be ascribed to non-ferrous metal working (450, 271, 295, 397, 507) but the material was not diagnostic of any deliberate metal working process.

Smithing slag and debris *consisting of the diagnostic residues from metal treatment, ie, smithing, tempering and similar working.*

The general appearance of the metal working finds indicates a common area or workshops and a variety of metals and techniques used. The bulk of the material consisted of slag lumps associated with iron working principally at a forging hearth. The sizes and shapes varied from small cinders to blocks weighing more than two kilograms; the typical shape was plano-convex, a characteristic form of smithing debris derived from the molten slag formed in front of and below the air blast from bellows, this being the hottest part of the fire. Examination revealed a form of silica-rich cinder with vesicular texture and inclusions of stone and sand; this is usually a product of sand used as a flux to clean the hot metal during the process of fire welding, the most common way of joining pieces of iron.

A small group of finds consisted of cores of iron encrusted with rust and sand classed as smithy debris. Usually these are the discarded waste pieces and off cuts from iron working. The fuel used was wood or charcoal and coal.

Particles of calcium carbonate compounds were scattered through the samples; this is a lime derivative, probably plaster, and without an obvious metal working connection.

Formation and development of slag lumps and hearth bottoms in iron working

Slags vary in colour, appearance, texture, specific gravity, etc. The variation of the slags can be used to indicate the process used and the type of artefact produced. A simple operation of heating a piece of iron in a charcoal fire would require an air blast to reach a temperature for the metal to be shaped; if the process was ended in a short time and the fire allowed to die down, a loosely formed porous slag lump with many voids and charcoal inclusions would be formed (typical of many of the smaller slag lumps). The continued work of shaping a number of objects or a single complex shape would form a more massive dense slag with ferrous silicate crystal growth and the base taking the shape of the hearth (420). The joining of pieces of iron by fire welding would have required the addition of sand or other siliceous material to flux scale from the work-piece, producing a glassy vitreous slag with sand or small stone inclusions (600).

The slags from the excavation indicate a full range of iron working techniques. The hammer scale from the site is too corroded by the wet site conditions to recognize the distinctive *flat hammer scale* (fairly pure oxidised iron) formed when quench-hardening hot steel. In any case, it is probable that wrought iron rather than carbon steel was the main stock material, in which case the quench-hardening technique would not be used.

Conclusions

The majority of the finds described as MWD were encased with concretions of sand, soil and pebbles bound together by iron compounds. These are amorphous orange-brown lumps with low magnetism which do not show any indications of vitrification or temperature alteration. These lumps form as the result of the re-deposition of iron compounds similar to iron panning, enhanced by association with iron objects or metal working debris.

The finds from this excavation have not indicated specific buildings or structures for metal working. The general appearance suggests a workshop in the near vicinity producing a variety of artefacts in iron, using hearths with charcoal and coal or coke as the fuel, hand operated bellows providing the necessary air blast to make and repair agricultural implements, tools, nails and carpentry fittings, etc.

Basic technology and metal working practices seem to have been in use and until further excavation reveals water lades, buildings and hearths or furnace structures the assumption is that these structures were not needed for the metal working carried out on or near this site.

The human remains

Julie A Roberts

Introduction

Background

The assemblage comprised nine individuals from a cemetery thought to be associated with St Laurence's Chapel, a small quantity of disarticulated remains, and a single outlying burial. The location and nature of the outlying burial, and the pathology identified on the skeleton strongly suggest that this was not a legitimate burial.

The age at death, sex, stature and body build as well as health status of each articulated skeleton was assessed in order to produce a demographic and epidemiological profile of the group. The disarticulated remains, which were in a very poor condition, are summarised in the archive, along with supporting information on individual articulated skeletons.

Preservation

A total number of ten articulated skeletons, from ten contexts, were analysed. Disarticulated remains from a further five contexts were found to represent a minimum number of four individuals. Preservation of the articulated remains ranged from poor to excellent, with 70% in poor or moderate condition (Table 3).

Table 3 *Preservation, sex, age and stature of articulated burials*

skeleton	**preservation**	**sex**	**age** (years)	**stature** (cm)
06 (031)	poor	?f	30–40	na
03 (585)	moderate	?f	35–45	na
707	moderate	m	40–50	173.01±2.99
09	good	?f	30–40	160.23±3.55
02 (454)	good	?m	35–45	158.84±2.99
1146/1235	excellent	m	15–18	na
08 (824)	poor	u	30–40	na
01 (370)	moderate	?m	30–40	170.17±3.27
05 (620)	poor	?f	60+	na
04 (605)	poor	u	6–9 months	na

Demography

Age at death

Methods used for determining age at death were in accordance with those outlined by Buikstra and Ubelaker (1994), Krogman and Iscan (1986) and Scheuer and Black (2000). In immature individuals, dental development and stages of epiphyseal fusion were the methods of choice, supplemented by metric data (Bass 1995; Ubelaker 1989). Where maturity was complete and where possible, the appearance of the pubic symphysis and auricular surfaces of the ilium, the sternal end of the fourth rib and dental attrition were considered. Age estimates for adults are less accurate than those for immature individuals and in order to compensate for this, wide age ranges are given. Those applied to the skeletons from Perth were as follows:

young adult (YA)	18–30 years
middle adult (MA)	30–50 years
mature adult (MTA)	50 years+

Age at death was not based on degenerative changes alone. Where epiphyseal fusion was complete but preservation of the skeleton was poor with no surviving dentition or diagnostic skeletal elements, individuals were classified as 'adult'. The term immature is used throughout this report when referring to the class of individuals aged less than 18 years. Immature individuals were subdivided into the following age ranges:

infant (INF)	3 months–3 years
young child (YCH)	3.1–6 years
older child (OCH)	6.1–10 years
young juvenile (YJ)	10.1–14 years
older juvenile (OJ)	14.1–18 years

No foetal or neonatal remains were identified.

Sex

Estimations of sex were based on the differences in male and female pelvic and cranial morphology (Buikstra and Ubelaker 1994), and the sizes of the articular surfaces of the long bones (Bass 1995). Due to poor preservation of a great deal of the skeletal material, determination of sex was problematic and secure designations were achieved in only two cases. The remaining cases displaying both male and female traits were given a probable sex.

Sexually dimorphic features do not start to develop until puberty, and as yet there are no universally accepted standards for determining the sex of juveniles (Buikstra and Ubelaker 1994).

Stature and body build

Living stature was estimated by measuring the long bones and applying standardised regression formulae (Trotter 1970). These calculations are based on data derived from white American modern males and females as no such data has yet been compiled for European archaeological populations.

Standard measurements of the proximal shafts of the femora and tibiae were made in order that platymeric and platycnemic indices could be calculated. The platymeric index measures the degree of anterior-posterior flattening of the femoral shaft, and the platycnemic index measures the degree of medio-lateral flattening of the tibial shaft. The extent of flattening is thought to be related to physical activity (Brock and Ruff, 1988). Standards used were after Bass (1995).

The general size of the bones, any pronounced muscle insertion points, and any morphological changes thought to relate to muscle activity, were recorded. Heavy and repeated usage of specific muscles during life can result in excess bone production at the point where the muscle inserts into the bone. Similarly unusual or repeated stress on a bone, particularly when it is still developing, can cause it to vary in shape according to the type of stress applied. In some cases it is possible to make inferences about what activities might have caused the bone growth, or unusual development, or to comment on the musculature of the individual concerned.

Craniometric data

Cranial measurements were taken with reference to *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994).

Non-metric traits

Non-metric traits are skeletal variants that cannot be measured on a metric scale, but are simply recorded as being present or absent on adult skeletal remains. They are thought to be genetically or environmentally determined, and are generally used in population studies to identify and compare different genetic groups. Cranial traits are of particular significance in population studies as they are less dependent on external factors such as occupation or habitual activities. Traits were recorded with reference to Finnegan (1978) and Berry and Berry (1967).

Health and disease

The recognition of pathological conditions in human skeletal remains is dependent on the preservation of specific skeletal elements, and the amount of surface erosion present. Certain diseases affect particular bones, and the lesions may have a characteristic distribution throughout the skeleton as a whole. Some conditions affect only the surface of the bone, and if that has been eroded evidence of pathological conditions can be lost. Even where excellent preservation exists it must be remembered that many diseases, such as acute bacterial or viral infections do not leave a trace on the skeleton, and children in particular can die as a result of infectious disease long before skeletal manifestations have a chance to develop. Diseases and traumatic injuries were classified according to cause with reference to a number of texts including Roberts and Manchester (1997), Ortner and Putschar (1981), Aufderheide and Rodriquez-Martin (1998), Galloway (1999) and Stuart-Macadam (1992).

Results

Age at death

The majority of individuals from Horse Cross were aged between 30 and 50 years at death. Of the ten articulated skeletons, seven (70%) were middle adults, one (10%) was an infant, one (10%) was an older juvenile, and one (10%) was a mature adult. Table 4 shows the numbers of individuals within each age category.

Table 4 *Number of individuals within each age category.*

age at death	number
birth – 2 months	0
3 months – 3 years	1
3.1 – 6 years	0
6.1–10 years	0
10.1–14 years	0
14.1–18 years	1
18 – 30 years	0
30 – 50 years	7
50+ years	1

The comparatively high numbers of dead in the middle adult category represents a typical mortality profile for an archaeological group from this time period. Other Scottish medieval sites have consistently shown this age category to contain the greatest number of individuals (Roberts and Manchester 1983, Brown and Roberts 2000), possibly reflecting a genuinely shorter lifespan during the medieval period, or problems associated with determining age in individuals over 30 years, in whom skeletal and dental maturity is complete. The low percentage of mature adults might be explained by shorter life expectancy or be attributable to the use of methods which have been cited as under-aging older adults (Roberts and Manchester 1997).

Sex

Determination of sex within this population was difficult due to the fragmentary nature of the remains. A definite or probable sex was assigned to eight of the individuals. Of these, four were definite or probable male and four were definite or probable female. Males and females were equally represented in the middle adult age category. The oldest individual, at 60+years, was female, and the youngest, at 15–18 years, was male. It was not possible to determine the sex of the infant skeleton.

Stature and body build

Stature

It was possible to calculate the stature of four individuals. The average male height was 167.34cm with values ranging from 158.84+/-2.99cm to 173.01+/-2.99cm. There was only one female skeleton in whom stature could be estimated, measuring 160.23+/-3.55cm in height. It can be seen from Tables 5 and 6 that these

Table 5 *Mean male statures from Scottish medieval sites.*

site and reference	period	average height (cm)	number
Isle of May (Roberts and Battley 1998)	5th – 17th century	172	37
Montrose (Roberts 1998)	medieval	166	1
Whithorn (Cardy 1994)	15th – 16th century	169	128
City Churches, Dundee (Brown and Roberts 2000)	12th – 15th century	171	30
Kinnoull Street, Perth (Bruce 1985)	medieval	170	4
Carmelite Friary on the Green (Cardy 1996)	13th – 16th century	171	21
St John's Kirk, Perth (Roberts 2005)	16th century	170	2
Horse Cross, Perth	15th century	167	3
Dunbar, DB09 and DB10 (Bruce 1994)	Early Christian	171	?
Logies Lane, St Andrews (Cardy 1993),	15th–16th century	169	14

Table 6 *Mean female statures from Scottish medieval sites.*

site and reference	period	average height (cm)	number
Isle of May (Roberts and Battley 1998)	5th – 17th century	160	6
Whithorn (Cardy 1994)	15th – 16th century	155	140
City Churches, Dundee (Brown and Roberts 2000)	12th – 15th century	158	27
Kinnoul Street, Perth (Bruce 1985)	medieval	153	2
Horse Cross, Perth	15th century	160	1
St John's Kirk, Perth (Roberts 2005)	16th century	154	3
Carmelite Friary on the Green (Cardy 1996)	13th – 16th century	155	13
Dunbar, DB09 and DB10 (Bruce 1994)	Early Christian	157	?
Logies Lane, St Andrews (Cardy 1993),	15th – 16th century	156	4

heights are consistent with those observed at other sites, the female being at the taller end of the range and the males being at the shorter end of the range. It should be noted however, that the mean male height was decreased as a result of one individual, Skeleton 02 (454), which measured only 158.84+/-2.99cm. While the length and robustness of this individual's bones appeared to be female, all pelvic traits scored as male. Unfortunately, there was no skull to analyse for sex characteristics. Possibly this individual had experienced some kind of deficiency in childhood which stunted growth.

Lower limb shape
It was possible to calculate nine platymeric indices for a total number of five individuals. Values ranged from 69.2 to 81.8 with the mean being 74. All the femora were platymeric, that is, flattened from front to back in the region of the upper shaft. This is a common finding in archaeological populations in contrast to modern ones where the shaft is more rounded in shape. This is thought to relate to the fact that our ancestors led a less sedentary lifestyle, and the mechanical stress placed on their femora was therefore greater.

Nine platycnemic indices were calculated for a total number of five individuals. The mean value was 68 with values ranging from 55.9 to 99.2. Two individuals, one male and one probable female, had platycnemic tibiae, that is, flattened from side to side; a male and a probable male had tibiae which were mesocnemic, that is, moderately flattened, and the remaining individual, a probable female, had tibiae which were rounded in the region of the proximal shaft. There was in fact quite a discrepancy between the indices of the latter individual (Skeleton 03), with the right having a value of 99.24 and the left 74.48. This could have been related to occupation or lifestyle, as could the variation within the group as a whole.

Craniometric data

Due to the fragmentary state of the skeletons, it was possible to record cranio-metric data on only three of the individuals. Results are presented in Table 7.

Few conclusions can be drawn from the above as there is insufficient data for comparison within the group.

Non-metric traits

Recording of cranial non-metric traits was difficult due to the highly fragmentary condition of the skulls. Those traits relating to the basi-cranium and the infracranium (the underside and inside of the skull) were the most poorly preserved. It was possible to assess only three crania for the presence of non-metric traits, and only one of these was sufficiently well preserved to allow the examination of more than four traits. Those identified included absent mastoid foramen, extrasutural mastoid foramen, maxillary foramen, absent zygomatico-facial foramen, and bridging of the

Table 7 *Cranio-metric data.*

note measurements are expressed in millimetres

	Skeleton 707	1146/1235	Skeleton 09
maximum cranial length		154	
maximum breadth		107	
bizygomatic diameter		90	
basion-bregma height		112	
foramen magnum length		34.5	
foramen magnum breadth		28.4	
mastoid length	R 35		L 30.5
upper facial height		72.2	
minimum frontal breadth		106	
upper facial breadth		100	
orbital breadth		L 35.4	
orbital height		L 33.9	
inter-orbital breadth		28.7	
nasal height		37.8	
mastoid length		L 30	
biauricular breadth		88	
bigonial width		98.6	
bicondylar breadth		108.6	
chin height		31.5	

supraorbital notch. This was too small a sample size for the frequency rates to be meaningful within the context of the site alone, but the data could prove to be useful in future comparative studies of medieval populations from different geographical regions.

While the post-cranial remains were better preserved than the cranial remains, it was still difficult to assess non-metric traits due to the high degree of fragmentation, pathology present, or the extreme weathering of the bone. Post-cranial traits were observable in six individuals, and present in five. Those identified included: Poirier's facet, acetabular crease, vastus fossa, double inferior talar facet and double anterior calcaneal facet. As with the cranial data, the numbers were too small for valid comparisons to be made within the group.

Health and disease

Skeletons from this assemblage displayed evidence of traumatic injury, periostitis, degenerative joint disease and dental disease. Articulated skeletons affected by these conditions are discussed below.

Trauma: fractures
Three of the individuals from this assemblage exhibited fractures, summarised in Table 8.

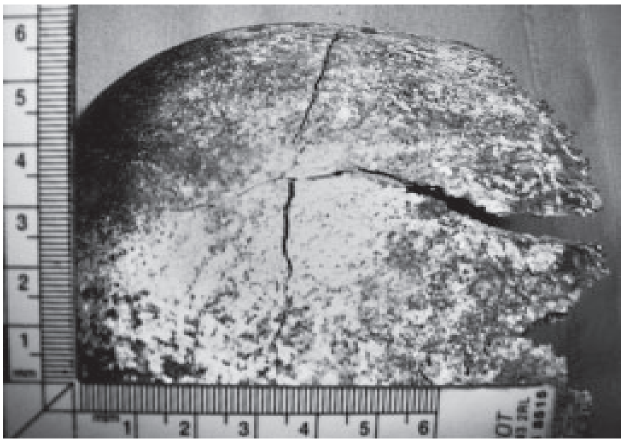
The clavicular fracture of skeleton 02 was located in the middle third of the bone and was healing at the time of death, as indicated by callous formation around the fracture site. Fractures to the clavicle are relatively common and in most cases are transverse and complete, and occur in the middle third of the element (Galloway

1999:114). Typically, they are not sex-specific in adults, although men do have a higher risk throughout life (Nordqvist and Petersson 1994 in Galloway 1999). Evidence has shown that these fractures are often a result of a blow to the shoulder, a fall with landing on the shoulder, an object falling and striking the individual on the shoulder or direct trauma to the bone (Galloway 1999:115).

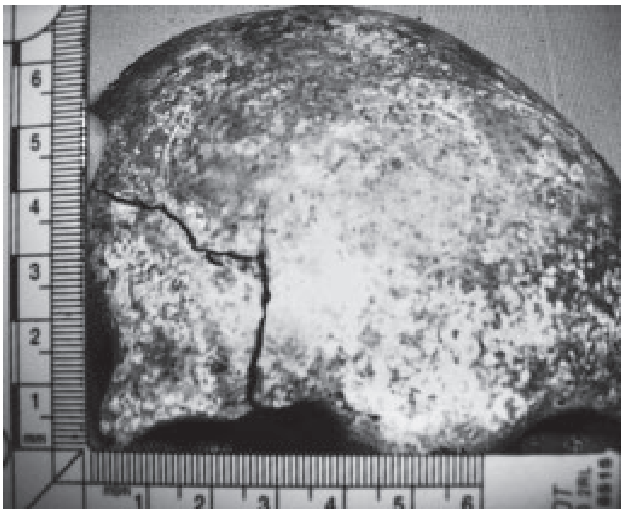
Skeleton 03 (585) showed evidence of a healed but malaligned fracture to the left distal ulna. Fractures to the ulna are generally associated with direct blows, which often occur as a result of the arm being raised in order to shield the body during interpersonal violence.

Table 8 *Fractures.*

Skeleton	age	sex	type of fracture
02 (454)	30–50	?m	healing, displaced fracture to right clavicle
03 (585)	30–50	?f	healed, malaligned fracture to distal ulna
1235 (1146)	15–18	m	2 perimortem, radiating fractures to skull



Illus 67 *Skeleton 1235, fractured cranium.*



Illus 68 *Skeleton 1235, fractured cranium.*

An impact to the area from a fall onto an outstretched hand can also be a cause. These types of fracture tend to cluster in the distal third of the element and are usually transverse or oblique (Galloway 1999).

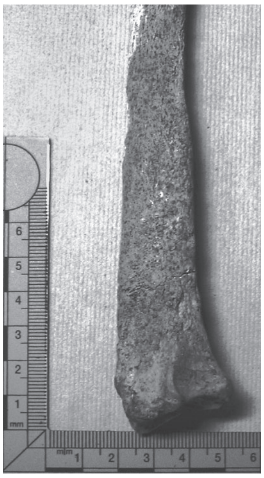
The outlying burial, Skeleton 1235 (1146) showed the most dramatic evidence of trauma in the form of two perimortem fractures, that is, fractures that had occurred around the time of death. One was a radiating fracture to the right parietal, the other a stellate fracture to the right frontal (Illus 67 and 68). Both fractures were slightly depressed and appeared to be the result of a blow to the skull with a blunt object. There were no signs of healing associated with these fractures, supporting the conclusion that the injuries occurred at or around the time of death. The location and type of injuries strongly suggest that this young man was assaulted, although interestingly two coins were found with the skeleton, (Holmes, above) perhaps suggestings that robbery was not the primary motive for the attack.

Periostitis

Periostitis, inflammation of the periosteum surrounding the bone, is frequently observed in archaeological populations. It can be caused by a number of conditions, including a specific infection such as TB or syphilis, non-specific infection perhaps incurred via direct injury to the surrounding soft tissues, or subperiosteal haemorrhaging, for example in scurvy. Reactive new bone growth may also occur in response to prolonged exposure to certain chemicals such as yellow phosphorous (Ortner and Putschar 1981: 131). The type of periosteal new bone (PNB) growth present can indicate the duration of the condition and whether or not it was still active at the time of death.

Periostitis was observed on five of the ten articulated skeletons (four adults and one juvenile). With the exception of Skeleton 03, all those affected were male or probable male. In all cases, more than one skeletal element was affected, and in three of the five affected individuals the condition was active at the time of death.

The majority of individuals exhibited periosteal changes on the lower limb bones, although Skeletons 01 and 1235 exhibited changes in other bones. In the case of Skeleton 1235 (1146), there was evidence of healed periostitis on all the shafts of the metatarsals, the sternal ends of left third, fourth and fifth ribs, and across the anterior aspects of all the lumbar and the 11th and 12th thoracic vertebrae. Two individuals, Skeletons 01 and 02, had widespread, prolific periostitis that was active at the time of death. In Skeleton 01, all of the long bones present were affected, with the most severe manifestation being seen in the ulnae and radii (Illus 69 and 70) This middle adult male appeared to have had multiple exposures to the agent(s) that had caused the reactive bone growth, as there were a number of different episodes of periostitis and evidence of both healed and active inflammation. Interestingly, the new bone growth was most prevalent on the distal ends of all the long bones. In Skeleton 02(454) all of the lower limbs, and in particular the tibiae and fibulae had



Illus 69 *(left)* **Illus 70** *(right) Periostitis of the radius, Skeleton 01.*

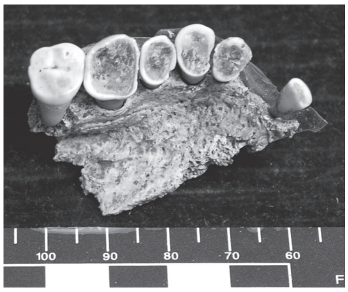
extensive PNB, and there was evidence of both healed and active inflammation.

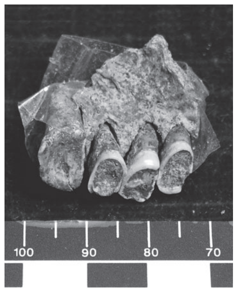
It is rare to see changes of this severity and frequency in such a small, discrete group, and the exact cause of the periostitis is unclear. It may have been caused by a specific or non-specific infection, but it may also have been a response to a specific chemical substance. In the period when the cemetery is likely to have been in use, the area known as Horse Cross seems to have been primarily an industrial area, used for tanning, dyeing and brewing. It is possible that the prolific periostitis was a pathological response to the chemicals used in tanning or dyeing. The location of the new bone growth on the forearms, as well as the more commonly observed lower limbs, supports this interpretation.

Dental disease

A total number of 126 teeth from seven sets of dentition were analysed. Five were from adults, one was from an older juvenile, and one from an infant (one tooth). Of these, four sets of dentition (57%) showed some form of oral pathology, including caries, periodontal disease, abscesses, antemortem tooth loss, dental enamel hypoplasia (DEH), and calculus. The overall condition of the teeth suggested poor oral hygiene.

Caries is an infectious progressive disease, which occurs when oral bacteria metabolise any fermentable carbohydrates present on a tooth. The tooth becomes de-mineralised and carious lesions form. There is a greater prevalence in populations whose diet is primarily carbohydrate based or where sugar consumption is high (Larsen 1984). Carious lesions affected six of the 126 teeth examined, a prevalence rate of 4.7 %. This is slightly higher than the 3 % observed in the skeletons from Dunbar (Roberts 1999a) and the 3.7% observed in the medieval skeletons from City Churches, Dundee (Brown and Roberts 2000). It was, however, comparable to the frequency rate of 5% observed at the Carmelite Friary in Aberdeen, and lower than that of 8% at the friary in Linlithgow (Cross and Bruce 1989, 139).





Illus *71 (top)* **Illus** *72 (left)* **Illus** *73 (right) Tooth wear, Skeleton 707*

Dental calculus or mineralised plaque was observed on six of the individuals from Horse Cross. It was not present on the one deciduous tooth. The calculus build-up on the majority of teeth was slight (classification after Brothwell 1981) however, there were 15 teeth in which it was of medium severity and three in which it was heavy. Dental calculus is an extremely common condition caused primarily by poor oral hygiene, and frequently observed on the teeth of archaeological skeletons.

Periodontal disease is a term used to describe the inflammatory changes which can occur in the soft tissues and bone around a tooth in response to plaque. As the disease progresses, resorption of the alveolar bone of the maxilla and/or mandible may occur and if the periodontal ligament becomes affected then the result can be ante-mortem tooth loss.

Four individuals suffered from periodontal disease. Two of the cases were slight, one individual had considerable periodontal disease around the area where a tooth been lost, but only slight disease elsewhere, and the fourth individual had moderate periodontal disease across the entire mandible and considerable disease around the molar area of the maxilla associated with ante-mortem tooth loss. A total of 20 teeth from three individuals were lost ante-mortem. In four instances, ante-mortem tooth loss was associated with periodontal disease and in two cases with dental abscesses.

The two abscesses were observed in the same individual, Skeleton 09, a middle adult probable female. The abscess on the right was large and associated with considerable periodontal disease as well as caries. The abscess on the left was moderate and also associated with considerable periodontal disease and caries. Abscesses occur as a result of infection within the pulp of the tooth, which can spread out into the apex of the tooth and then into the periodontal ligament. Localised resorption of the bone around the tooth root then occurs, which is eventually followed by the formation of a hole through which the pus escapes.

Dental enamel hypoplasia (DEH) is the name given to the defects, linear grooves and pits which appear in the enamel when there has been a cessation in the growth and development of the tooth. These defects are considered to be indicators of physiological stress, such as febrile infections, malnutrition, metabolic disorders, and severe psychological disturbance during childhood (Aufderheide and Rodriguez-Martin 1998; Goodman et al 1984). Slight DEH was observed on eleven (8.7%) of the 125 adult teeth examined. This frequency rate was slightly lower than the 10% observed at St John's Kirk, Perth (Roberts 2005).

In addition to the oral pathology identified, there was an exceptionally high degree of attrition to the vast majority of the teeth from the site at Horse Cross (Illus 71, 72 and 73). The wear was evident on the anterior and posterior teeth and suggested either that this group of people had been eating foods that contained a high level of gritty substances, or that perhaps they had been using their teeth in association with their occupations, for example, softening leather by chewing.

A number of dental anomalies were also observed, including marked prognathism (an overbite which, again, could have been related to occupation), rotated canines and first premolar, mandibular tori, and agenesis of a lower third molar.

Degenerative joint disease and spinal joint disease

Degenerative joint disease or osteoarthritis is often the most frequently identified pathological condition in any archaeological population. It is characterised by osteophytes (bony projections), porosity and eburnation (polishing) of the joint surface. The aetiology of the disease is multifactoral, the most common causes being age and repeated stress. It may be primary or secondary (developing after a traumatic injury) and factors such as diet, heredity and endocrine agents may also play a role (Roberts and Manchester 1997).

Spinal joint disease is characterised by the same changes described above, together with the additional characteristic of Schmorl's nodes. These four criteria are used to assess the severity of the disease and one, all, or a combination of the features may be present. Schmorl's nodes represent herniations of the contents of the inter-vertebral discs onto the superior and inferior surfaces of the vertebral body. They tend to occur in older juveniles and young adults in whom the discs are still turgid. Often they are the result of a compression force, which might be sustained during heavy lifting or a fall onto the feet, and they may accompany actual compression fractures.

Degenerative joint disease was present in only two individuals from this assemblage, and in both cases it was the spine that was affected. Skeleton 05, the 60+ year old probable female, had osteophytes on the upper thoracic vertebrae, and Skeleton 09, a middle adult probable female, had slight osteophytes on the upper and lower thoracic vertebrae. Schmorl's nodes were present in isolation in Skeleton 370, a middle adult probable male, affecting the 11th thoracic and five additional unidentified thoracic vertebrae. These lesions alone do not constitute spinal joint disease and might be an indication that the individual was engaged in heavy manual labour from an early age.

The presence of degenerative joint disease was extremely low in this group, however, it is important to note that it was difficult to assess, due to the fragmentary nature or absence of the joint surfaces, in particular those of the vertebrae. It is possible that there was a higher prevalence of the disease but that it was not observable.

Other pathological conditions

A number of minor pathological conditions affecting the vertebrae were observed. Skeleton 1235/1146 had an osteoma on the lateral side of the bodies of the fifth and sixth cervical vertebra, and the posterior neural arch was unfused to the left lateral mass. In Skeleton 01, syndesmophites (bony spurs) of approximately 3mm were present on the lamina of the thoracic vertebrae.

Disarticulated Remains

A small quantity of disarticulated bone was recovered from four contexts and 'site clearance'. Preservation of the remains was poor, and the majority of individuals were represented by small to medium fragments of a single element or tooth. In three instances, the fragment of bone or tooth allowed the age of the individual to be determined with some accuracy.

A minimum number of four individuals were identified from the material: one adult, one older juvenile/young adult (aged 12 to 19 years), one child (aged five to six years) and one young to middle adult (aged 25–35 years. It was not possible to estimate the sex or stature of any of the adults. No skeletal or dental pathology was identified, but this was largely due to the poor state of preservation of the remains. One non-metric trait was observed, a Carabelli's cusp on the upper left first molar of the child.

Conclusions

The nine individuals buried within the single-phase cemetery at Horse Cross might represent a discrete group of workers who had been engaged in a particular trade, or perhaps they were members of the same family.

With the exception of the baby, all were aged over 30 years at death, which was in sharp contrast to the population from St John's Church, Perth. There was an equal balance of males and females and appeared to be no bias between the sexes in terms of life expectancy.

The group displayed no evidence of nutritional disorders, but an unusually high proportion of individuals displayed evidence of prolific periosteal new bone growth. Inflammation of the periosteum in response to prolonged exposure to toxic agents is well documented, and some of the chemicals that would have been used in the dyeing and tanning industries at the time could have caused this type of reaction. The distribution of the lesions did not suggest any specific infection such as tuberculosis, and it would be unusual for a non-specific infection to cause such widespread changes. If sufficient DNA is preserved in the bone, it is possible that biomolecular analysis might elucidate the cause of the periosteal new bone growth, by identifying the DNA of any pathogens present. It could also determine whether or not the individuals were related.

The outlying burial too, provided an interesting story. It is extremely rare to be able to determine cause of death in archaeological skeletal remains, but in this instance there can be no doubt that the young man met a violent end as a result of several blows to the head. He was subsequently buried in a shallow pit, and both the construction of the grave and the fact that he still had coins in his pocket suggest that he was disposed of rapidly and robbery was not the primary motive for the murder.

Mammals, birds and mollusc shell

Catherine Smith

Methods and measurement

The mammal and bird bones were identified by direct comparison with modern comparative material and were allocated to particular bone and species where possible. Where it was not possible to identify bones as far as species, the terms *large ungulate*, *small ungulate* and *indeterminate mammal* were used. Thus all large vertebrae other than the atlas and axis were described as large ungulate, while small vertebrae were described as small ungulate. Ribs were similarly allocated depending on their size. Large ungulate bones were most likely to have come from cattle, but could also have come from horse or red deer. Similarly, small ungulate bones were most likely to have come from sheep, but could possibly have originated from goat, pig or roe deer. All other mammalian fragments for which neither species nor bone could be ascertained were described as indeterminate mammal. Boessneck's (1971) criteria for differentiating between the bones of sheep and goat, which are morphologically very similar, were applied where feasible.

Measurements were made in accordance with the scheme of von den Driesch (1976) and are expressed in millimetres. Additional measurements on the humerus follow Legge & Rowley-Conwy (1988). Mandibular tooth wear and eruption patterns were assessed using Grant's (1982) scheme for cattle, sheep/goats and pigs, as well as Payne's (1973) scheme for sheep/goats. Horn cores were aged using Armitage's (1982) criteria.

Details of all fragments in medieval and post-medieval Phases 1 to 4, including species, particular element, side, state of fusion, dentition and anatomical measurements, where appropriate, were recorded on a spreadsheet ordered by context and phase (Microsoft Excel format) and form part of the site archive. Molluscan remains were recorded by weight and species, ordered by context and phase. A full catalogue is also part of the site archive.

Species present

Bones of mammals, birds and fish (see Ceròn-Carrasco, below) as well as shells from marine mollusca were all retrieved from the site. In medieval Phases 1 to 3 the following mammalian species were recorded: cattle, sheep/goat, pig, horse, red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), dog, dog/fox, cat and hare (*Lepus capensis*). In addition to these species, bones of fox (*Vulpes vulpes*), rat species (*Rattus* sp) and small mammals of mouse or vole size were recovered from post-medieval Phase 4 (see Table 9).

Birds recorded in Phases 1 to 4 were domestic fowl (*Gallus gallus*) and domestic/greylag goose (*Anser anser*). Duck bones, possibly from the mallard (*Anas platyrhynchos*) were present in Phase 2. A single bone of swan, probably the mute swan (*Cygnus* cf *olor*), was recovered from post-medieval Phase 4 and one bone of raven (*Corvus corax*) from Phase 3. One turkey bone (*Meleagris gallopavo*) was found in later post-medieval Phase 5 (see Table 9).

The molluscan assemblage was almost completely dominated by oyster shells (*Ostrea edulis*) which occurred in all phases from 2 to 6. Much smaller quantities of other marine bivalves were also recovered. Mussel (*Mytilus edulis*), and cockle (*Cerastoderma* sp) were found in Phases 2, 3 and 4 and *Spisula* sp in Phase 3. Marine gastropods were also found in small quantities, wulk/periwinkle (*Littorina littorea*) in Phases 2, 3 and 4, limpet (*Patella* sp) in Phase 2, buckie (*Buccinum ondatum*) in Phase 4, netted dog-wulk (*Hinia* sp) in Phase 3 and dog-wulk (*Nucella lapillus*) in Phase 5. The single freshwater species recorded was the freshwater or pearl mussel (*Margaritifera margaritifera*), which was noted in Phases 2 and 4. The total weight of molluscan shells from all species recovered from Phases 1 to 6 was 48.3 kg, of which 46.6 kg was oyster shell. A further 16.8 kg of shells was recovered from unstratified

Table 9 *Total number of animal bone fragments in Phases 1–4, by species.*

note totals exclude unattached deer antlers [shown thus] and individual dog skeletons (sk)

	number of fragments				
species	*Phase 1*	*Phase 2*	*Phase 3*	*Phase 4*	*total*
cattle	48	456	446	755	1705
sheep/goat	31	349	389	648	1417
goat		1		6	7
pig	26	41	41	56	164
horse		21	13	19	53
red deer, bone		2	3	2	7
red deer, antler		[2]	[1]	[3]	[6]
roe deer, bone	1	2	6	6	15
roe deer, antler					
dog		20	20 +sk	3 +sk	43 +sk
dog/fox		1	7	6	14
fox				1	1
cat		6	2	4	12
hare	1		1		2
rat				1	1
small mammal				1	1
large ungulate	65	365	299	542	1271
small ungulate	20	90	136	237	483
indet mammal	159	418	1042	1016	2635
domestic fowl	2	21	27	28	78
goose	2	16	8	18	44
duck cf mallard		2			2
swan cf mute				1	1
raven			1		1
indet bird		3	8		11
total	355	1814	2449	3350	7968

Table 10 *Minimum numbers of animals in Phases 1–4, based on most commonly occurring anatomical elements.*

	Minimum Number of Individuals (MNI)			
species	*Phase 1*	*Phase 2*	*Phase 3*	*Phase 4*
cattle	3	9	8	18
sheep/goat	3	21	16	31
goat		1		2
pig	2	2	3	2
horse		1	1	1
red deer		1	1	1
roe deer	1	1	1	1
dog		3	3	2
dog/fox		1	2	1
fox				1
cat		2	1	1
hare	1		1	
rat				1
domestic fowl	1	3	3	4
goose	1	3	1	2
duck		1		
swan cf mute				1
raven			1	

Table 11 *Percentages of food-forming mammals in Phases 1–4, based on fragment count.*

	Percentage of food-formers				
species	*Phase 1*	*Phase 2*	*Phase 3*	*Phase 4*	average
cattle	45.3	52.3	49.7	50.6	49.5
sheep/goat	29.2	40.0	43.3	43.4	38.9
goat		0.1		0.4	0.3
pig	24.5	4.7	4.6	3.8	9.4
horse		2.4	1.4	1.3	1.7
deer	0.9	0.5	1.0	0.5	0.7
(red, roe)					
total	99.9	100.0	100.0	100.0	

and un-phased contexts. A summary by species for medieval and post-medieval Phases 1 to 4 is available in the archive.

Relative frequency of mammals

Numbers of fragments from each species, and an estimate of the minimum number of individuals in Phases 1 to 4 are shown in Tables 9 and 10. Minimum numbers of animals have been estimated using the most frequently occurring bone from each species in each phase.

On the basis of fragment count, cattle are the most frequently occurring domestic mammal. In Table 9, 1705 bone fragments in Phases 1 to 4 are from cattle, compared with 1417 from sheep/goat. Sheep/goats, although less frequent in terms of fragments, appear to be more numerous when minimum numbers of animals present are estimated. Thus in Phase 2 only nine individual cattle are estimated to have been present while at least 21 sheep/goats are represented (Table 10). Similarly in Phases 3 and 4 the numbers of individual cattle are fewer than those of sheep/goats. However, at an urban site such as Horse Cross, where bones are the product of butchery or other-animal based industry rather than the burial of individuals, minimum numbers are by no means an accurate tool. Large bones of large animals like cattle may be rendered unrecognisable to a greater degree by butchery, whereas those of smaller animals such as sheep may still retain diagnostic characteristics even when reduced to small fragments. In addition, joints of meat containing bones may be removed and dispersed far from the site of butchery. Thus minimum numbers will tend to be biased towards the smaller species, or those which have been buried more or less intact for whatever reason.

Comparing percentages from the main food-forming mammals (cattle, sheep/goat, pig, horse and deer species; see Table 11) indicates that in the earliest phase of the site, medieval Phase 1, cattle were more frequent in terms of fragment count, and equal in terms of minimum numbers. This conforms to the pattern observed at earlier medieval sites in Perth, such as 75–77 High Street (PHSAE) some 500m to the south of the present site, Mill Street and King Edward Street. The relatively high proportion of sheep/goat remains found in the

Table 12 *Comparison of percentages of main food-forming mammals at sites in Perth (based on fragment count).*

Note unattached antler fragments of deer are omitted * indicates sheep and goat are expressed as one figure

References 1 Hodgson et al (forthcoming) 2 Smith (1997) 3 Hodgson and Jones (1982) 4 Smith and Hodgson (1987) 5 Smith (1995) 6 Smith (1996a) 7 Hodgson and Jones (1984) 8 Smith (1996b) 9 Smith, unpublished 10 Smith (2003)

	food-formers (%)					
site	*cattle*	*sheep/goat*	*goat*	*pig*	*horse*	*deer*
High Street (PHSAE)[1]	63.5	22.2	4.9	8.3	1.0	0.1
80–86 High Street[2]	51.4	35.1	2.8	10.1	0.4	0.2
St Ann's Lane[3]	57.6	32.8	*	8.9	0.4	0.2
Methven Street[4]	81.5	17.3	*	1.2		
Kirk Close[4]	76.1	18.7	*	4.8	0.2	0.1
Mill Street[5]	62.7	26.3	4.1	3.8	3.0	0.2
King Edward Street[5]	62.6	23.3	2.8	10.5	0.5	0.3
Kinnoull Street[5]	63.1	29.3	*	7.6		
Blackfriars House[5]	67.1	21.4	*	11.4		
Scott Street[6]	66.7	27.8	0.2	3.0	2.1	0.2
Canal Street I[7]	58.2	32.1	0.1	5.8	3.6	
Canal Street II[4]	67.7	27.1	*	3.4	1.8	
Canal Street III[8]	66.0	28.1	*	4.5	1.3	0.1
Meal Vennel Phases 1–3[6]	65.2	23.9	2.6	6.9	1.1	0.1
Meal Vennel Phases 4–5[6]	74.3	17.4	1.3	5.8	0.8	0.4
Meal Vennel Phases 6–7[6]	62.0	30.8	0.4	4.6	2.0	0.1
St John's Square (PEX 55, 58, 59)[9]	61.3	22.2	3.5	9.2	1.0	2.9
Salvation Army, South Street[10]	48.6	41.7	*	5.1	4.3	0.4
Horse Cross Phase 1	45.3	29.2		24.5		0.9
Horse Cross Phase 2	52.3	40.0	0.1	4.7	2.4	0.5
Horse Cross Phase 3	49.7	43.3		4.6	1.4	1.0
Horse Cross Phase 4	50.6	43.4	0.4	3.8	1.3	0.5

later medieval and post-medieval phases at Horse Cross are more similar to those recorded at the Salvation Army site, South Street, as well as St Ann's Lane and Canal Street 1 (Smith 2003, 84). Table 12 presents comparisons between 15 sites of medieval date within the burgh of Perth.

The low frequency of pig remains at Horse Cross, with the exception of Phase 1, is generally typical of the medieval and post-medieval period in Scotland. The proportion of pig bones in Phase 1 is unusually high at 24.5% of the total food-forming mammals, but this is probably a result of the relatively small sample size for this phase (355 bones were present in Phase 1, out of a total of 7968 for all phases; see Table 9).

Horse remains accounted for an average of 1.7% of the total food-forming mammals at Horse Cross, a not untypical result for the medieval and post-medieval period in Perth. Deer remains (excluding unattached antlers, which may have been imported to the site independently of the carcass) occur in small numbers in all phases and are an indication that animals were hunted for their meat.

Ages of domestic animals at death

Age at death for cattle, sheep/goats and pigs was estimated both on the basis of mandibular tooth eruption and wear pattern and on the state of epiphyseal fusion of long bones. Of the two methods, assessment of tooth eruption and wear pattern is generally considered to provide the more reliable result. Cattle horn cores were also attributed to age class following the method of Armitage (1982).

Cattle

Cattle long bones in Phases 1 to 4 were assessed as to the state of epiphyseal fusion, that is whether the articulatory ends (epiphyses) were fully fused to the shaft (diaphysis), partly fused (fusion line visible) or unfused. The results enabled the bones to be categorised as F (foetal or neonatal), J (juvenile), J/I (juvenile or immature), I (immature), I/A (immature or adult) or A (adult). Unfortunately there is a degree of overlap in the dates at which fusion takes place in different individuals. In addition, in some bones, the epiphyses fuse at a stage prior to full adulthood, but later than the juvenile period. This occurs for example in the proximal phalanges, hence a fused phalange can only be described as belonging to an immature or adult animal. If many phalanges are present, there is a tend-ency for the results to be biased towards I/A category.

Further, not all bones can be assessed in this way, because of damage caused by butchery or post-

Table 13 *Age categories of cattle long bones in Phases 1–4.*

F foetal/neonatal F/J foetal/neonatal or juvenile J juvenile J/I juvenile or immature I immature
I/A immature or adult A adult

age category	Phase 1		Phase 2		Phase 3		Phase 4		Phases 1–4	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
F	1	6.3							1	0.2
J			5	3.4			2	0.8	7	1.3
J/I	1	6.3	13	9.0	29	19.7	24	9.6	67	12.0
I			3	2.1	1	0.7	2	0.8	6	1.1
I/A	10	62.5	70	48.3	61	41.5	114	45.4	255	45.6
A	4	25.0	54	37.2	56	38.1	109	43.4	223	39.9
total	16	100.1	145	100.0	147	100.0	251	100.0	559	100.1

Table 14 *Age classes of cattle horn cores in Phases 2–4. (After Armitage [1982])*

age class	age inference	Phase 2		Phase 3		Phase 4		Phases 1–4	
		n	%	*n*	%	*n*	%	*n*	%
3	young adult			2	28.6	2	13.3	4	16.7
4	adult	2		3	42.9	4	26.7	9	37.5
5	older adult			2	28.6	9	60.0	11	45.8
total		2		7	100.1	15	100.0	24	100.1

Table 15 *Age categories of sheep/goat long bones in Phases 1–4.*

F foetal/neonatal F/J foetal/neonatal or juvenile J juvenile J/I juvenile or immature I immature
I/A immature or adult A adult

age category	Phase 1		Phase 2		Phase 3		Phase 4		Phases 1–4	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
F					1	0.7			1	0.2
F/J					1	0.7	1	0.4	2	0.4
J			8	6.3	13	8.8	6	2.3	27	5.0
J/I	7	46.7	28	21.9	23	15.5	52	19.9	110	19.9
I	1	6.7	7	5.5	11	7.4	10	3.8	29	5.3
I/A	4	26.7	29	22.7	39	26.4	98	37.5	170	30.8
A	3	20.0	56	43.8	60	40.5	94	36.0	213	38.6
total	15	100.1	128	100.2	148	100.0	261	99.9	552	100.2

depositional factors. The results of the available evidence are presented in Table 13. One very young calf (foetal or neonatal) died in Phase 1. Bones of juvenile (J) or juvenile /immature (J/I) cattle were present at low levels in all phases from Phase 1 to Phase 4 but accounted for less than 20% of all fragments assessed as to age. Immature/adult (I/A) and adult beasts were in the majority (or evidence for them survived better). The highest proportion of adults occurred in Phase 4, where 43.4% of the total fragments assessed for age were from adults. Average occurrence of adults across all phases was 39.9%.

Evidence from horn cores also supported a high adult survival rate (see Table 14). Across all phases, 16.7% of horn cores were placed in Armitage's (1982) age class 3, 37.5% in class 4 and 45.8% in class 5/6, the last being mature adults.

Sheep

Tooth wear was assessed using the schemes of Grant (1982) and Payne (1973). Those mandibles which had been damaged by butchery or post-depositional breakage were attributed to Payne's wear stages where appropriate. Sample sizes were not large, consisting of one mandible in Phase 1, 14 mandibles in Phase 2, 18 in Phase 3 and 16 in Phase 4. In Phases 2, 3 and 4 at least one lamb was killed between the ages of two to six months in modern terms (Stage B), while none appeared to have been killed between the ages of six months and one year. Certainly no mandibles survived in this age group. The peak age at which sheep/goats were killed was between the ages of two to three years (Stage E) in Phases 2, 3 and 4, while there was an additional peak between three and four years in Phase 4. The oldest surviving animal was killed between the ages of six and eight years in Phase 2.

Epiphyseal fusion evidence correlated fairly well with tooth evidence (Table 15), indicating a small number of very young lambs in Phase 3, corresponding to Stages A and B. Those animals which were killed in the juvenile or immature category (J/I) correspond roughly with those at Payne's Stage D. Culling appears to be at a peak in the immature or adult (I/A) and adult age categories (A) which unfortunately cannot be further separated due to the overlapping ages at which bones fuse (Silver 1969, 285–6). However, there is a good correspondence with the ages provided by the mandibular evidence, indicating a peak at Stages E and F (two to four years).

Although the cull pattern for sheep/goats at the Horse Cross site appears to indicate that only a few animals were killed when very young, it should be borne in mind that these are the very animals from which bones and mandibles are least likely to survive, due to their relative fragility. Thus the results will tend to be biased in favour of more sturdy bones from older animals, as indicated by epiphyseal fusion ages. It is perhaps surprising, then, that few mandibles of older sheep survived, given that animals in the range of 8–10 years have been found on other sites in Perth, for example PHSAE.

Pig

By contrast with cattle and sheep/goats, more pigs died at a young age. On long bone evidence, it would seem that most of the pigs died before reaching maturity: in Phases 1–4 (Table 17) only 13.4% of the assessable long bones came from adult pigs. This contrasts with 38.6% for sheep/goats and 39.9% for cattle (Tables 15 and 13). However, 60% of the available mandibles came from adult pigs (Table 16). There is therefore some discrepancy between results derived from mandibular as opposed to epiphyseal fusion evidence. This may be due to a variety of factors, including a low sample number for mandibles (n=10 for mandibles, compared with 67 for long bones) and differential preservation of mandibles and long bones. Since sheep/goat ages derived by these two methods were similar, small sample size is likely to be a contributory factor.

Sizes of animals

Anatomical measurements were made on the long bones where possible and are summarised in the archive.

Cattle

With only a few exceptions, the dimensions of the bones fell within the ranges of those recovered from the medieval excavations at PHSAE (Hodgson et al, forthcoming). In Phase 1, all long bone measurements fell within the ranges from PHSAE with the exception of a single distal femur from Horse Cross which was slightly larger. Mean measurements were equivalent to, or less than the comparable PHSAE means. In Phases 2, 3 and 4, 27 mean measurements were greater than the PHSAE

Table 16 *Estimated ages of pig mandibles. (After Habermehl [Bull and Payne 1982])*

estimated	Phase 1		Phase 2		Phase 3		Phase 4		Phases 1–4	
age at death	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
c 8 months							1	20.0	1	10.0
8–13 months							2	40.0	2	20.0
13 months							1	20.0	1	10.0
20 months +	1		3		1		1	20.0	6	60.0
total	1		3		1		5	100.0	10	100.0

Table 17 *Age categories of pig long bones in Phases 1–4.*

F foetal/neonatal F/J foetal/neonatal or juvenile J juvenile J/I juvenile or immature I immature
I/A immature or adult A adult

age category	Phase 1		Phase 2		Phase 3		Phase 4		Phases 1–4	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
F					1	6.3	1	4.8	2	3.0
F/J					2	12.5			2	3.0
J			2	11.1					2	3.0
J/I	4	33.3	8	44.4	6	37.5	14	66.7	32	47.8
I			2	11.1	1	6.3	2	9.5	5	7.5
I/A	2	16.7	6	33.3	5	31.3	2	9.5	15	22.4
A	6	50.0			1	6.3	2	9.5	9	13.4
total	12	100.0	18	99.9	16	100.2	21	100.0	67	100.1

means and ten were smaller. In Phase 4, two measurements (on the atlas vertebra and proximal humerus) were slightly smaller than the minimum recorded for the same bones at PHSAE.

A few bones were recovered intact, allowing calculations of withers (shoulder) height to be made. A metatarsal from Phase 2 with a greatest length (GL) of 203.0mm came from a beast estimated to have stood at 110.6cm at the withers (Fock, quoted in von den Driesch 1974). In Phase 4, two metatarsals provided estimates of 101.8cm and 106cm at the withers; these estimates fall comfortably within the range of 95.6cm–113.4cm at PHSAE calculated from the length of the metatarsal. The beasts from which these bones came were therefore typically short in stature compared with modern animals.

Sheep/goat

As with the cattle, almost all of the sheep/goat measure-ments fell within the ranges recorded at PHSAE. The single exception was a proximal femur from Phase 3 which was 1.4mm larger. Mean measurements in Phases 2, 3 and 4 exceeded those for the PHSAE mean in some cases (36 instances) and were smaller than the corres-ponding means in 13 instances, but always falling within the overall size range.

Where intact long bones survived, withers heights were calculated using Teichert's (1975) factors for the radius, metacarpal and metatarsal. In Phase 3 the height range based on the radius was estimated at 52.9cm–59.8cm and in Phase 4, based on the same bone, was 56.8cm. Also in Phase 4 a height of 56.0cm was estimated from a complete metatarsal. All of these estimates for Phases 3 and 4 fell well within the range of withers heights of 46.7–65.8cm at PHSAE.

Pig

All measurements fell within the ranges at PHSAE, with the single exception of a third phalange from Phase 1. Withers heights were calculated from the length of the astragalus, (after Teichert 1969, quoted in von den Driesch and Boessneck 1974). In Phase 1, 2 and 3 single examples provided estimates of 67.7cm, 74.6cm and 70.3cm respectively. These estimates fall within the range of 55.5–82.3cm at PHSAE. The typical medieval pig was a rangy, long-legged and probably athletic animal, and these animals from Horse Cross would have been of a similar build (Smith 2000, 712–3).

Horse

Although few horse measurements were available from the earlier phases at Horse Cross, two bones, a metatarsal and a femur survived in Phase 4, allowing withers heights to be calculated (Kieswalter quoted in Ambros and Muller). One bone, the metatarsal, came from an animal of 145.5cm or 14:1 hands height while the femur was from a smaller animal of 134.1cm or 13 hands height, where a hand is a horse-measuring unit of 4 inches. As these animals both stand at under 14:2 hands height, they are considered to be ponies, and are typical in stature for medieval working animals (Smith 1998, 872).

Dog

Dog remains comprised semi-complete skeletons in Phases 3 and 4 (Context 445; Illus 21 and Context 390) as well as isolated bones in Phases 2, 3 and 4. Calculations of shoulder heights after the method of Harcourt (1974) indicated that in Phase 2, animals of approximately 45cm and 57cm were present (Contexts 572 and 579). In Phase 3, a skeleton came from an animal of about 57cm while another individual was much larger, at about 72.5cm high at the shoulder. The largest dog was about the same height as a modern lurcher, while the smaller animals were more similar in size to modern Border collies.

Butchery

There was ample evidence of butchering implements and techniques provided by cuts and hacks on many of the bones. Tools used in all phases were primarily axes or cleavers, and metal knives. There was little evidence for saws having been used in medieval domestic butchery, although three sawn long bones were noted in later post-medieval Phase 5 (Contexts 772 and 819).

Primary butchery

Removal of head and horns
Butchery of an animal carcass usually involves removing the head and feet at an early stage of the process. At Horse Cross, decapitation of cattle was often achieved by chopping between the first two cervical vertebrae, the atlas and axis. This procedure most often resulted in cutting through the odontoid process of the second cervical vertebra. In other cases, the axe blow was positioned between the head and the first cervical vertebra, resulting in removal of the occipital processes from the back of the skull.

Cattle, sheep and goat horns could also be removed at this stage of the process. The outer horny sheath of the horn was the part used for making artefacts, and it was therefore important to cause as little damage to it as possible when removing it from the bony horn core. Occasionally, saws would be used in this process, as noted in a cattle horn core which was sawn across at the base (Phase 2, Context 350). In most cases, however, horns were chopped free from the skull, as in an example from a goat (Phase 4, Context 169). However, it is also possible to remove horns by the simple method of burial and allowing decomposition of the soft tissue attaching the outer sheath to the bony core. After a few weeks, the horn will slip off with minimum effort. Horn cores with knife cuts around the base, or on the frontal bone of the skull were probably inflicted during this type of removal (cattle; Phase 2, Context 350).

Removal of lower limbs

The lower limbs, including the feet (hooves) are generally dealt with during primary butchery. As they are relatively meatless, they may be discarded, thrown to the dogs, or used in some way unrelated to food productions, such as artefact production, boiling up for glue or production of neat's foot oil, a lubricant for leather. There is copious evidence among the bones from Horse Cross for foot and lower limb removal, showing a range of levels of skill. Less skilled butchery (or perhaps evidence of a less than sharp instrument) was shown in a cattle calcaneum (tarsal) bearing at least five medio-lateral hacks on the anterior part of the shaft and two sagittal hacks on the posterior aspect (Phase 4, Context 169). A more skilled butcher with a sharp axe should have been able to sever this relatively narrow bone with one blow. However, it is preferable to free the lower hind limb from the carcass by aiming the blow lower down the leg, distal to the tarsals, at the meta-tarsal, and many examples of medio-laterally chopped cattle metapodia found at the site are probably evidence of this process. Chopping through the metatarsal preserves the Achilles tendon, or hamstring, which runs from the back of the knee to the point of the hock at the calcaneum. The hamstring is traditionally used to suspend the hind limb, by inserting a hook between the tendon and the bone.

Removal of the phalanges (toe bones) is indicated by knife cuts on a cattle distal metacarpal, located on the articular surface itself, at the lateral edge of the medial half of the articulation with the first phalange (Phase 3, Context 361).

Carcass splitting

Many vertebrae presumed to have come from cattle and sheep/goats (classified as large and small ungulate) were butchered in such a way, in the median (sagittal) plane, as to indicate that some carcasses were divided equally into sides of beef or mutton. Other, laterally divided vertebrae, indicated that division took place on a table or floor while chopping along the animal's flanks (Armitage 1982b, 98).

Splitting the carcass also involves halving the pelvis and there are numerous examples of chop and hack marks at the pubis of cattle, sheep/goats and pigs, indicating the production of symmetrical sides of meat.

Secondary butchery (disjointing)

Clear evidence of secondary butchery is often difficult to recognise since the process is frequently overlain by marks inflicted during the tertiary processes of meat removal. Evidence of disjointing is more apparent on the bones of cattle than it is on those of sheep/goat and pig, probably because smaller animals require less butchery in order to convert them into manageable joints of meat.

Sites on the carcass where marks consistent with disjointing might be expected are the joint between the scapula and the proximal humerus; the joint between the distal humerus, the proximal radius and the olecranon of the ulna; the joint between the proximal femur and the acetabulum of the innominate and the joint between the distal femur and proximal tibia. Thus, numerous parallel knife cuts around the tubercles of a proximal cattle tibia are interpreted as secondary butchery (Phase 3, Context 813), as is the small slice cut from the head (caput) of a proximal cattle femur (Phase 3, Context 409). Separation of the knee joint is demonstrated in a cattle distal femur from which a small slice has been removed (Phase 3, Context 335) and a cattle patella with similar damage on the posterior aspect (Phase 2, Context 350).

Tertiary butchery

Cutting flesh from bone

Numerous examples of cuts, presumably made by metal knives when meat was removed, were recorded on bones of domestic cattle, sheep/goats and pigs as well as on the bones of deer. Bird bones (domestic fowl and goose) were also affected.

Spines were removed from cattle scapulae in a number of instances in Phases 2, 3 and 4 and it is thought that this occurred during stripping of the meat, the spine itself being relatively thin and thus easy to cut through with a sharp blade. The meat from a beef shoulder joint is known as spall steak in Scotland. There is less meat on the blade-bone of a sheep, but there is just enough to make a dish known as a 'puir man o' mutton' which was traditionally grilled before the fire (McNeill, 1974, 184).

Marrow splitting

As at many other sites of medieval and post-medieval Scotland it is apparent that little was wasted when a carcass was butchered. Once all the meat had been removed, the bones themselves were cracked open in order to obtain access to the marrow contained within them. This was achieved by standing long bones on end and splitting them in the sagittal plane with an axe or cleaver. Many cattle bones from Horse Cross have evidently been split in this way. A sheep metatarsal (Phase 3, Context 105) which has been split cleanly between the distal condyles has probably been placed upright on its flat proximal surface, with the distal condyles upright, allowing an accurate blow to be struck in the narrow space between the condyles.

Perforated sheep/goat tibiae were probably also evidence of marrow removal. Five tibiae from Horse Cross had rough holes bored through their distal ends; three of the examples had unfused epiphyses and it can be assumed that it was far easier to punch a hole through the soft, unfused surface than through the dense material of a fused bone (Phase 2, Contexts 350, 1241; Phase 4, Context 169, 295; Phase 6, Context 396). Perforated tibiae, metapodials and less frequently, radii, have been found at other Scottish medieval sites. The perforations may be rough or smooth edged, and they are usually to be found, as in the cattle examples, in the proximal articulation, extending into the marrow cavity. Examples are known from Perth, King Edward Street (metatarsal), Meal Vennel (two metacarpals, one metatarsal; two proximal radii) and PHSAE (three metatarsals, one metacarpal, one distal tibia). Bigelow (1993) has reviewed the occurrence of bi-perforated sheep metapodials from Norse sites on Shetland. These bones are usually pierced twice, once in the anterior or posterior surface just above the distal articulation, and again in the proximal articulation, as in the medieval examples from Perth (ibid, 441). He concludes that these holes have been made in order to extract marrow, the hole near the distal end being used to create a draught when sucking out the marrow. If this is indeed the reason for most of the perforations in medieval sheep bones, it would also explain why the holes also occur in the proximal articulation of the radius and the distal tibia.

Some cattle long bones also showing evidence of further, heavier butchery. Thus a cattle tibia shaft was chopped several times in a medio-lateral direction, subsequent to sagittal splitting (Phase 2, Context 579). Similar heavy butchery was noted in a cattle metacarpal with hack marks on its inner, trabecular surface, underlying the sagittal chopping (Phase 4, Context 1363) and in a cattle tibia (Phase 4, Context 1432). These bones appear to have had the marrow removed before the bone was further chopped. Possibly the bones were then boiled in order to obtain the fats, or to make soup stock for cookery.

Brain removal

It is obvious that all parts of the animal carcass were used, either in cookery or in industrial processes, and that little was left to go to waste. Brains were also used, as the evidence of sagittally split skull fragments show (eg goat skull, Phase 4, Context 169). The brains could be cooked and eaten alone, or more likely, a traditional dish called powsowdie, or sheep's heid broth, was made. This required the head to be singed, boiled and split open (MacNeill, 1974, 184). Ox heads were used to make the dish later called potted heid, or Scots brawn, one 'good-sized' head yielding 16 pounds in weight of the prepared dish (ibid 180). A mixture of putrefied brains could also be rubbed on to hides to assist in the preparation of leather (Cornwall 1968, 98).

Butchery of dog, cat, fox and horse

It is not surprising at a site of medieval or post-medieval date in Scotland to find bones of animals such as dogs, cats, horses and foxes which show marks of butchery. A catalogue of such bones from Horse Cross is shown in Table 18.

The dog and cat bones on which knife cuts were found were the humerus, femur and tibia, all from later medieval Phase 2. The cuts could have been made while removing the animals' pelts. However the positioning of cuts on bones such as the femur, which does not lie near the surface of the body where damage caused by skinning might be expected to occur tends to indicate that the meat may also have been removed. Peltry from dogs and cats was an item of trade in 16th century Scotland (Smith 1998a, 877).

Parallel cuts were also noted on the basal border of a fox mandible (Phase 4, Context 130). Similarly placed cuts have been found on the lower jaws of cats from other medieval sites in Perth (PHSAE and 80–86 High Street) and on dog mandibles from Ladyhill, Elgin and are thought to be associated with skinning (Smith 1998a, 877; Smith 1998b, 773).

The knife cuts on the affected horse bones from Horse Cross are also mainly indicative of skinning, and the fact that several are also gnawed by dogs suggests the dual purpose of producing meat for dog-food. However, where dog-gnaw marks are absent, consumption of meat by humans cannot be ruled out.

Table 18 *Catalogue of butchered horse, dog, cat and fox bones.*

Phase	context	species	bone	details
2	350	cat	L tibia, entire	possible knife cut on shaft
2	572	dog	R femur, entire	multiple parallel shallow cuts along anterior shaft, lateral edge
2	579	horse	L femur, distal	2 abraded probable knife cuts, anterior distal; shaft probably chopped medio-laterally
2	579	dog	L humerus, unfused	multiple small knife cuts, shaft
2	579	dog	L femur, entire	probable knife cuts
2	589	horse	L humerus, distal	knife cut on shaft. Probably chopped medio-laterally
2	600	horse	L mandible	knife cut, buccal aspectPossibly chopped dorso-ventrally
2	600	horse	R humerus, distal	knife cuts (underlying dog gnaw marks)
4	130	fox	R mandible	2 parallel knife cuts on basal border
4	169	horse	L astragalus	distal facet chopped at articulation with metatarsals; knife cut, anterior
4	169	horse	metapodial, distal	shaft sawn medio-laterally (small lug present)
4	1315	horse	metapodial, shaft	chopped dorso-ventrally/sagittally
4	1432	horse	R tibia, entire	fine knife cuts along anterior crest; dog-gnaw marks

Those horse bones which are chopped are all from the lower limbs, that is the astragalus (Phase 4, Context 169) and metapodia (Phase 4, Contexts 169, 1315) and may have been removed from a skinned carcass. One metapodial (169) has in fact been sawn across, imply-ing that it was intended to be used in artefact manu-facture. A bone awl, possibly made from a horse splint, was recovered in Phase 2, Context 579 (see Table 21) and it thus seems that horse bones were selected for modification as artefacts.

Working of antler and bone

Table 19 is a catalogue of antler fragments, worked bone offcuts and worked bone artefacts. The antler fragments are mainly from red deer (*Cervus elaphus*) although a lesser number are from roe deer (*Capreolus capreolus*) and provide evidence of antler working in Phases 2, 3 and 4. Many of the antlers have been obtained from deer which have been killed (ie the antler is attached to a skull fragment) and although there are no definite fragments of cast antler it is possible that this was also a source of raw material. With the exception of two fragments in Phase 2, all were probably offcuts. The two artefactual pieces were a beam fragment with iron residues adhering, and a split beam fragment, both of which were possibly broken handles (Context 350, 579)

Among the worked bone fragments were a pig metapodial through which a hole had been bored to form a 'snorie-bane', so called from the snoring noise it made when rotated quickly by means of a twisted cord fastened round it (Phase 4, 905). Perforated pig metapodia are a common find on medieval Scottish sites in Perth, St Andrews and Aberdeen (Ford unpublished; Cameron et al 2001, 209). They are also known from the Viking period and the Iron Age in Scotland (Ballin Smith 1994, 171) and from continental European sites such as medieval Hitzacker and Dannenberg in Germany (Kocks 1978, 210).

A number of artefacts from Phase 5, including a group of shell and bone buttons appear to be of fairly modern, machine-made, manufacture. One of the buttons may be of ivory, with possible diagnostic transverse rings apparent on the edge of the button (Phase 6, Context 168). Also of ivory, presumably elephant, is a polished annular ring, possibly a napkin ring or curtain ring, probably of relatively recent manufacture (Phase 5, Context 747). This context was associated with a late 18th-century tenement on Castle Gable. A fragment of double-sided one-piece bone comb with finely spaced teeth is also of relatively recent manufacture and is probably part of a nit comb, used for removing head-lice from the hair (Phase 5, Context 292). By contrast with the offcuts and artefacts from Phases 2, 3 and 4, none of the Phase 5 and 6 group of artefacts is likely to have been made on the site. A broken crochet hook, of the type described in early modern pattern books as 'coarse' and generally used for working wool worsted, was found in Phase 4 (Context 169). The early origins of crochet are disputed, and it is unlikely that the technique we know at the present day was practised before the second half of the 17th century, only becoming popularised in the early 19th century. The crochet hook from Horse Cross appears too modern for a Phase 4 date in the 15th/16th centuries. However, Context 169 is the uppermost midden layer of that phase, and comes from a disturbed area at the very northern edge of the excavation; thus it would not be surprising if this artefact is in fact of a later date.

Other materials of animal origin: baleen

A heavily degraded fragment of whale baleen was recovered from Phase 2, Context 572 (identified by Sonia O'Connor, Department of Archaeological Sciences, Bradford). Baleen is a keratinous tissue which takes the place of teeth in the mouths of whales of the sub-order Mystaceti and is an unusual find in an archaeological context. It is often known as 'whalebone', despite being of non-bony origin. Whales were hunted for their blubber, meat and baleen from the earliest times, although commercial whaling by Europeans did not begin until c1500 AD, when Basque fishermen establish-ed the fishery in the Atlantic (Watson 2003, 8).

Baleen was prized for use as a stiffening material in clothing because of its combination of flexibility and strength. A Scottish lady's court dress of 1603 included a bodice stiffened with whalebone: 'ane par of quallbon bodis, the on[e] syd with taffetie, and the oder syd with small canvos' (Maxwell and Hutchinson 1958,32). A man's doublet in the collection of Perth Museum and Art Gallery, dating to c 1620 (accession number 2004.107), still includes the original whalebone; two sticks are inserted down the left and right front edges respectively in order to keep the garment in shape (Sue Payne, pers comm).

In the latter part of the 19th century, the major consumer of baleen was the brush industry. MacGregor (1985, 183) describes a process which included boiling the raw material for 12 hours before cutting into strips or filaments suitable to be used as bristles in brushes of various sizes. It was also used in whip handles, riding crops, fans and umbrella ribs (Carwardine et al 1998, 36) and continued to be used in women's corsetry and clothing.

The baleen from Horse Cross was recovered from a late 13th- or 14th-century context (Phase 2) and thus pre-dates the fashion for rigid, stiffened clothing. The fragment comes from what appears to be a well-sealed midden deposit, within the fills of the medieval ditch, and seems to be a genuinely early example of the use of this material, though its purpose in this case cannot be known.

Pathology

A complete catalogue of abnormal and pathological bone may be found in the archive.

Table 19 *Worked bone and antler catalogue.*

Phase	context	species	bone element	details
2	350	red deer	antler	beam fragment; iron adhering to medulla; possible artefact handle
2	350	cattle	horn core	base sawn across
2	579	red deer	antler	beam fragment; long edges trimmed, one short edge cut roughly, other short edge broken; outer and medullary surfaces filed smooth
2	579	?horse	?splint	wider end roughly shaped; trabeculae exposed; small recessed perforation to depth of 1mm in anterior surface, near wider end; narrower end of object trimmed to a point, now broken; broken awl fragment, length 61.1 mm, max width 9.5 mm, thickness 6.2 mm
3	182	probably small ungulate		broken bone tube; external surface polished; 3 circular grooves incised; internal surface = marrow cavity of bone
3	334	roe deer	antler	tine; multiple knife cuts at base
3	335	red deer	antler	tine; base sawn cleanly; some medulla removed?
3	813	red deer	skull/antler	7 x parallel hacks at base of antler; beam roughly chopped across
3	886	red deer	skull/antler	knife cut on pedicle, hack at base of antler, wear/polishing on base of antler
4	169	red deer	skull/antler	brow, bez tine and beam sawn; width of saw cut 2mm
4	169	large ungulate	bone	coarse crochet hook; length 74.3mm, diameter 5.3mm; cylindrical, solid rod with flattened platform (for gripping); polished surface, appears machine-made
4	203	red deer	antler	tine, recently broken
4	229	red deer	skull/pedicle	base of pedicle hacked
4	229	roe deer	skull/pedicle	base of pedicle hacked
4	280	large ungulate	long bone shaft fragment	very abraded condition; possibly a yarn-winder? Knife cuts on internal and external surfaces; deep medio-lateral cut, external
4	295	red deer	antler	beam and ?brow tine; base and upper part of beam sawn cleanly, tine sawn (small edge lug)
4	295	red deer	antler	tine; base and tip sawn
4	905	pig	L metacarpal III	hole (diameter 5.2mm) bored through shaft in antero-posterior direction; 'Snorie-bane'
5	292	large ungulate	bone	double-sided one-piece comb; length 35.1mm, width 38.4mm, thickness 1.5mm; broken; teeth regularly spaced, closely set; machine cut; probably a nit comb
5	309		mollusc shell	button; diameter 16.3mm, thickness 2.0mm; circular button derived from mother-of-pearl; 4 thread holes set in central recess; probably machine-turned
5	747		ivory	ring; external diameter 36.5mm, internal diameter 27.0mm, thickness 6.5mm; solid, one-piece ivory ring; polished on all surfaces, although now abraded; possible napkin or curtain ring?
5	772		bone	button; diameter 17.1mm, thickness 2.6mm; circular button; 4 thread holes set in central recess; machine-turned
5	772		bone	button; diameter 17.4mm, thickness 2.8mm; circular button; 4 thread holes set in central recess; machine-turned
6	168		bone/ivory	button; diameter 17.4mm, thickness 2.1mm, circular button; 4 thread holes set in central recess; machine-turned

Congenital conditions

Dental health of the domestic animals appears to have been good, in as much as there was little evidence of dental disease. However, this may be due to breakage of many of the mandibles. Two cases of congenital dental conditions were however noted: these were a cattle mandible in which the fifth cusp (third pillar) of the third molar was reduced in size (Phase 3, Context 1434) and a sheep/goat mandible in which the second pre-molar was absent (Phase 4, Context 1315). Both of these conditions occur in medieval sheep and cattle populations and have been noted in assemblages throughout Scotland. The health of the animals would not have been adversely affected.

Other congenital conditions noted in the Horse Cross material were small perforations in the parietal bone of cattle skulls (Phase 3, Context 1129; Phase 4, Contexts 1432). These perforations occur fairly frequently in medieval cattle from Scotland and have been recorded in Scotland at Mill Street, Perth (Smith nd), 53–59 Gallowgate, Aberdeen (Smith and McCormick 2001) and College Goods Yard, Glasgow (Smith, 1986 archive report) and elsewhere in Britain (Baker and Brothwell 1980, 37–8).

Inflammatory conditions

A fragment of cattle skull may have come from a beast with a damaged horn core (Phase 2, Context 589). The right horn core consisted only of a pitted stump or scur. Although the horn core was abraded, the edges were smooth, implying healing had taken place. A perforation of the type described above was also present in the left parietal. It is possible that the animal had been artificially polled (de-horned). A similar example from which both horns were removed in life was noted at Meal Vennel, Perth (Smith, nd).

A massively deformed pig tibia showed symptoms of an inflammatory condition, probably osteomyelitis (Phase 4, Context 229). Externally, the remnant of the distal fibula was roughened, porous and fused to the distal tibia shaft, which was affected by a smooth swelling, most marked on the anterior shaft. The bone had been butchered across the swollen area. Internally, the marrow cavity of the tibia shaft was infilled with a dense, sclerotic bone mass. Infection may have reached the bone by spread from overlying tissues, perhaps as a result of injury, or via the blood-stream (Baker and Brothwell 1980, 64). The condition would certainly have caused pain and lameness in the pig and may have been a factor in deciding to cull the animal.

Diseases of joints

There were many instances of fairly trivial lesions consisting of small depressions in the articular surfaces of cattle phalanges, corresponding to Baker and Brothwell's (1980) Types 1 and 2. These lesions are unlikely to have caused harm to the affected animal, unless accompanied by more severe symptoms such as the grooving and eburnation noted in a Phase 2 phalange (Context 1234). Similar small interarticular lesions also occurred in cattle metapodials (Phase 2, Contexts 350, 579; Phase 4, Contexts 905, 1432).

Osteoarthritis was seen in a cattle skull which was affected by grooving, eburnation, compaction, pitting and lipping of the articular surface of the occipital condyle (Phase 3, Context 1057).

Traumatic damage in a dog skeleton

The skeleton of a small, elderly dog (Phase 5; Contexts 507/510) was affected by severe deformities of the forelegs. The left radius and ulna may have been fractured at some point in the dog's life, partially healing but failing to unite well. A false joint appears to have formed in the left ulna but the lower part of the radius had either been resorbed completely or was not recovered by excavation. The length of the persisting radius shaft was 45.8mm, with extensive callous formation of pitted, osteophytic bone at a distance of 19mm from the proximal articulation, although the shaft ended in a smooth-edged lesion. By contrast the length of the radius from the opposite (right) leg was 84.6mm. Compensation for the abnormalities in the left leg resulted in modifications to the right; the shaft of the right radius was markedly bowed and there was eburn-ation of the distal facet. In the right ulna, the shaft had expanded to form a bony flange in the midshaft region. In addition, there was remodelling of the femur head in the left hind leg, with some new smooth bone form-ation around the edge of the caput. These changes may also have been a response to the damage in the right foreleg.

The animal may have suffered direct trauma to the leg, although it is possible that the fractures occurred as a response to some underlying condition. There is little doubt that the animal's gait would have been uneven and the condition must have caused pain. Despite this, the dog appeared to have survived into old age, the dentition showing heavy wear, and its eventual burial in a pit rather than disposal on a rubbish heap showed a degree of care.

Discussion

Evidence of tanning pits, lime pits, heather yards and barkhouses in the Castle Gable and Curfew Row area is first documented in the 17th century (Perry, above) and is backed up by the archaeological evidence of tan pits in Phase 3 (late 14th/15th centuries), and Phase 4 (15th/16th centuries). While it is difficult to relate any of the bones of cattle, sheep/goats or pigs found on the site to this industry, the evidence from cut bones of dog, cat, fox and horse found in Phases 2 and 4 indicate that they are the by-products of skinning or tann-ing. Although the Phase 2 bones pre-date the earliest record of tanning in the vicinity, they may indicate the beginnings of the industry at this location in the late 13th/14th century. Analysis of the follicle pattern of leather fragments found at the site (Thomas, above) indicated that both cattle hide and goat skin was utilised. The leather may well have been produced near to the site.

The excavations also provided evidence of other animal-based industries at the Horse Cross. Antler offcuts were found in Phases 2, 3 and 4 indicating a small-scale industry, drawing raw materials from both red and roe deer, many of which had been killed for their meat. The remainder of the antler assemblage may well have been collected where the deer had shed them, but in the absence of cast antler fragments, there was no direct evidence of this. Cattle, sheep and goat horn cores, some of which were sawn or otherwise bore cut marks were evidence of horn working, although the quantities of horn cores were nowhere near as great as were recovered from the PHSAE site to the south of the present excavation.

The animal bones seem therefore to indicate an are a of activity based on the products of animal carcasses, where horn and antler working took place alongside the tanning of hides and skins from domestic animals ranging in size from horses to cats. Discarded bones from these industries found their way into middens along with the refuse from butchery and domestic consumption. Effluent resulting from these activities would have been malodorous to say the least. It seems to have been common practice in the medieval period to banish polluting activities such as tanning, tallow-rendering, fulling, flax-retting and so on to the outskirts of the burgh, which fits very well with the location of the Horse Cross site.

The fish remains

Ruby Ceròn-Carrasco

Methods

The fish remains from Horse Cross were retrieved from bulk soil samples that were subsequently sieved through 250μm and 1mm mesh sieves and by hand collection during the excavations. A total of 24 contexts contained fish bones.

All the fish remains were identified, where possible, to species level or to family group, using a modern fish bone reference collection. Nomenclature follows Wheeler and Jones (1989, 122–3). All elements were examined for signs of cutting and burning. The colour of burnt bone was recorded to allow investigation into the nature of burning, i.e. cooking, rubbish disposal, etc. The full results of the identification of the remains are available in the archive.

The examples of the cod-family species (Gadidae) were allocated to approximate size ranges. This was done by matching the archaeological material to modern fish skeletons of known size based on total body length. Therefore, elements were categorized as 'small' (15–30cm), 'medium' (30–60cm), 'large' (60–120cm) and 'very large' (over 120cm length). The size of identified non-Gadoid species was also calculated by comparison to modern specimens of known size, and examples were given the category 'juvenile' or 'adult', depending on the size range.

The recording of the preservation state of the fish bone was based on two characters: texture on a scale of 1 to 5 (fresh to extremely crumbly) and erosion, also on a scale of 1 to 5 (none to extreme). The sum of both was used as an indication of bone condition; fresh bone would score 2 while extremely poorly preserved bone would score 10 (after Nicholson 1991).

Results

The summary of species present and NISP (Number of Identified Species) by element per phase for both the sieved and hand-collected material are given in Table 20. As this is a small assemblage, both the sieved material and the hand-collected remains have been considered in the overall analysis.

The level of preservation of the fish bone was consistent, in terms of fragment size and condition. Most of the material was quite eroded and fragile. Bones were most frequently 20–70 % complete. Their condition score was generally in the range of 7–9, indicating poor to extremely poorly preserved bone.

A few of these fish remains were burnt white which would indicate burning at high temperature possibly as a result of rubbish disposal.

A total of five taxa were identified, consisting of three identified to species and two to family level. All these were from marine fish species.

Discussion

The main group of fishes represented was the Gadidae, cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) being the most abundant species present. Rocker (*Raja clavata*) was also present as well as other unidentified Elasmobranch fishes (i e skate, rays and sharks).

Although the range of species is limited in this small fish bone assemblage, the remains reflect fishing from boats using baited lines for the catch of the medium to very large gadids as well as other species such as skate, and fishing from the shore from rocks for the catch of small specimens of the cod fishes.

All the fish remains derived from ditch fills, rubble and midden deposits, implying they are a product of domestic rubbish disposal; some of the bones were calcined which further suggests burning and disposal of domestic rubbish. Skeletal elements from the head and vertebral column were recovered implying that the fish were brought to the site whole, although probably gutted.

The fish remains from Horse Cross derive from five broad phases of relative dates ranging from the late 13th to early 19th centuries. The most likely source of the fish recovered at Horse Cross is the east coast, particularly the Fife and Tayside areas where large scale fishing was already established from the 13th century (Anson 1950), an important commercial industry that

Table 20 *Summary of fish remains, using NISP (Number of Identified Species).*

species	Phase	1	2	3	4	5
cod	*Gadus morhua*	4	3		2	2
haddock	*Melanogrammus aeglefinus*	1	2	3	1	
Gadidae	Cod family	3	2	6	5	2
rocker	*Raja clavata*		1			
elasmobranch			1			

reached its peak between 1840 and the 1880s (Brown 1996, Grey 1978, Lockhart 1997). The 'white fisheries', that is, fishing for cod family species in particular, as well as the herring fishery, were the main industries supplying fresh fish such as cod and haddock to inland settlements such as Perth.

Albeit a small fish bone assemblage, the fish remains recovered at Horse Cross provide important information on the Scottish fishing industry through time, particularly in terms of the social and economic components of the periods here represented. These analyses serve to reflect the important and valuable contribution of the fishing industry in Scotland which provided a fresh source of nourishment to vast numbers of the population, not only along coastal settlements but also to inland settlements such as Perth.

Environmental samples

Mhairi Hastie

Introduction

Bulk soil samples were taken from a range of features during excavations at Horse Cross in Perth. During the excavation, four potentially waterlogged samples which indicated that preservation of both waterlogged and charred palaeoenvironmental remains was good were assessed. A further 20 samples were processed and assessed following the excavation. Full results are available in the site archive.

Sample processing method

The samples were processed through a system of flotation in a Siraf style flotation tank. The floating debris (flot) was collected in a 250μm sieve and, once dry, scanned using a binocular microscope. Any material remaining in the flotation tank (flot) was wet sieved through a 1mm mesh and air-dried. This was then sorted and material of archaeological significance removed.

Results

Carbonised plant remains

Low quantities of carbonised cereal grain, including oat and barley, and weed seeds were recovered from four samples, Contexts 904 (Phase 1), 595 (Phase 2), 1065 (Phase 3) and 901 (Phase 3/4). Wood charcoal was present in the majority of samples, but in low quantities.

Waterlogged plant remains

Three samples, all from midden deposits, were found to contain waterlogged organic material (Contexts 572, 1057 and 1315). Samples from Contexts 1057 (Phase 3) and 1315 (Phase 4) were dominated by seeds of wild taxa indicative of agricultural fields and waste ground, including *Chenopodium album* (fat hen), *Lapsana communis* (nipplewort) and *Polygonum persicaria/ lapathifolium* (persicaria/pale persicaria). Two weeds associated specifically with cultivated fields were present, *Raphanus raphanistrum* (charlock) and *Chrysanthemum segetum* (corn marigold). These species are now diminished in the modern weed assemblage due to the use of herbicides in the 19th and 20th centuries. Occasional weeds more indicative of damp ground or heath were also recovered; buds of *Calluna vulgaris* (heather/ling), seeds of *Carex sp*. (sedge) and fragments of moss. In addition, degraded fragments of wood and small twig debris were present in both samples and hazelnut shells were recovered from Context 1315 only.. In the absence of species associated with standing or flowing water, the good preservation of the samples may suggest a change in the water table during the occupation of the site.

Context 572 (Phase 2)

This sample contained a range of waterlogged material including fruit pips, hazelnut shell and weed seeds commonly associated with waste places and cultivated land. It was clear that the more delicate material had disintegrated. Occasional fig seeds (*Ficus carica*) and seeds of bramble (*Rubus fruticosus*) were recovered. These remains are usually associated with human faecal material. Other species present such as *Hyo-sycamus niger* (henbane) are indicative of high nitrate disturbed ground. Henbane was used as a mild narcotic during the medieval and post-medieval period.

One uncharred grape pip (*Vitis vinifera*) and a small number of uncharred bramble seeds were present in the flot of the sample from Context 595. No evidence was found during the excavation to suggest that these deposits were waterlogged. The recovery of uncharred grape pips and other plant material from this deposit therefore suggests either that this context has been contaminated by later material, or that preservation of plant material was reasonably good but that the plant remains were never present in any abundance.

Other materials

Other materials included medieval pottery (Contexts 904 (Phase 1), 595 and 1050 (Phase 2), 707 and 1434 (Phase 3), 358 (Phase 4) and 583 (Phase 5)). A small fragment of iron nail was recovered from Context 257 (Phase 5).

Fragments of non-ferrous slag and cinders were recovered from Context 1434 (Phase 3).

Building material was represented by small quantities of coarse lime mortar Contexts 904 (Phase 1), 707, 1000 and 1065 (Phase 3), 583 and 257 (Phase 5). Fragments of slate were also recovered from Context 257 (Phase 5).

Organic materials included occasional fragments of leather (Contexts 572 (Phase 2) and 257 (Phase 5). None of the leather fragments were obviously worked. Fragments of large mammal bone, both burnt and unburnt, were recovered from the majority of samples.

In addition, occasional fragments of fish bone, particularly fish vertebrae, were present in Contexts 1141 (Phase 1), 1050 (Phase 2), 1000 (Phase 3) and 257 (Phase 5). Small-abraded fragments of marine shell were re-covered from Context 572 (Phase 2) and 1434 (Phase 3), including oyster, mussel and periwinkle (wulk) shell.

Discussion

Domestic waste, such as bone, pottery and marine shell dominates the samples. The grave fills, Contexts 707, 1065 and 1146, were found to contain the remnants of domestic debris probably resulting from midden material incorporated into the grave back-fills.

Wood charcoal was present in most samples. Coal and cinders were recovered from a number of samples associated with Phase 3 and 4. The evidence suggests that wood or charcoal was used as the primary fuel during the earlier phases while coal was utilised during the later phases. Since the coalfields were located in East Fife this could be evidence for the shipping of coal up the River Tay to Perth.

Three contexts contained waterlogged plant remains, Contexts 572, 1057 and 1315. The majority of plant taxa recovered from these samples were indicative of waste places and disturbed ground. Similar results were gained from the four samples initially assessed at the start of the excavation (Contexts 169, 295, 589, 600). The bulk of the material is derived from domestic debris, naturally accumulating plant remains from the surrounding areas, and flooring or bedding material consisting of straw, moss, bracken and small twigs.

The absence of aquatic plants in the waterlogged samples indicates that the samples were only damp enough to result in anaerobic conditions needed for the preservation of the plant remains. A number of processes could have produced such deposits, for instance organic material in negative features being below the water table or changes in the water table during the occupation of the site. In addition, documentary evidence from the Perth Guildry Book indicates that the River Tay flooded regularly during the medieval/post-medieval period and this could have saturated the midden deposits sufficiently to aid preservation of the organic remains.

Midden deposits 572 and 595 (Phase 2) contained low concentrations of fig seeds, grape pips and fruit stones. Their occurrence, particularly of fig and grape, within the midden deposits suggests the presence of sewage and may indicate the existence of cesspits or latrines on the site during this phase. Figs and grapes, usually in dried form, were imported from southern Europe throughout the medieval period. Similar assemblages have been uncovered during the excavations at Perth High Street and at other Scottish medieval archaeological sites.

Carbonised cereal grains were recovered from a number of samples including the fill of a grave (Context 1065), both oat and barley being present. The majority of the grains were highly abraded and the charred re-mains are likely to represent material reworked from domestic and other contexts, with hearth, kiln and oven material all being mixed by repeated building, pit cutting and bioturbation. There is no evidence to suggest that any of the carbonised plant remains were burnt in situ, and the low-level of re-worked cereal grain/weed seeds recovered is unlikely to relate to the function of the features/deposits from which they were recovered.

Discussion

David Bowler

The Horse Cross excavation set out to answer a number of specific questions, and despite certain difficulties has generally succeeded, though not always quite as expected.

The central question was the location of the medieval castle. Very definite light has been shed on this by the discovery of the deep, wide north–south ditch (Phase 1), with traces of a palisade along its western edge (Phase 3). Given the castle's destruction by a violent flood, it was always unlikely that any of the castle superstructure would survive, and deep cut defences were precisely the sort of feature that might have been expected. What was surprising was the location of this ditch, as its northern projection ought to have been found in the Blackfriars' House excavations of 1984, and was very definitely absent. It must have terminated or turned just beyond the northern limits of the present excavation, either under the road (North Port) or under the unexcavated southern half of the Blackfriars House car park.

The existence of the palisade along the edge of the ditch was not surprising, as this is a natural way of improving a ditched defence. However its position on the west side was unexpected, suggesting that the ditch was enclosing something further west, not east. Also unexpected was its phasing, apparently in a later re-use of the ditch, presumably well after the destruction of the castle by flood. These circumstances make better sense when taken together, suggesting that the palisade was enclosing either the Blackfriars' lands, or the suburb that grew up under their protection. It is known that the Blackfriars' lands were enclosed by various ditches, as John Shirley's account of the murder of James I in 1437 describes how the assassins had to improvise a bridge of planks to gain access to the precinct (Stevenson (1837) 55, 60).

The chapel of St Laurence was also expected. It was known that the Blackfriars had neglected it when it came into their possession (Perry, above), and that it had already fallen into disuse by 1493. However, it was very striking how little of it survived; an irregular fragment of clay floor, the very badly disturbed graves, one shard of painted glass, part of a ceramic ring-vase candelabrum, and some very uncertain structural features, all very near the surface, barely escaping destruction under the modern industrial buildings and their demolition.

The industrial character of the late medieval and post-medieval suburb was already known, and was amply confirmed by the evidence of tanning and metal-working on the site, and more tantalisingly by kiln props from an otherwise elusive pottery. Interestingly, the skeletons from St Laurence's Chapel may also show evidence of exposure to dangerous chemicals during life, perhaps associated with one of these processes (Roberts, above).

The medieval and later development of the suburb is an area of considerable interest. The stone-arched bridge (Phase 3) across the northern end of the ditch was an entirely unexpected trace of the suburb's developing road system, perhaps an early predecessor of North Port directly to the north.

The social character suburb was also strikingly illustrated in this excavation. The presence of tanneries and other noxious industries would not have made it a desirable location. The neglected chapel with a dog-burial adjacent, and another, later dog burial not far away, give a suggestion of the area's character, especially at a time when dogs were not often held in great esteem (Smith 1998a). A quaint indication of what might be expected is given in one of the Blackfriars' charters; the friars, feuing out a garden or orchard and stone-built house to Andrew Farar the skinner, found it necessary to stipulate that he must not assign any buildings on the property 'to any schoolmaster to teach or maintain a group of boys therein, nor to any persons keeping a house of ill repute', …*aliquibus personis publice fornicantibus et in hujusmodi artibus illicitis perseverantibus* (Milne (1893) 86, No XXXVII.2). The discovery of a 14th-century murder victim (Phase 3), a young man beaten over the head and thrown into a pit, gives startling confirmation of the area's bad reputation.

This is in marked contrast with the ceramic evidence. The assemblage from this site is exceptionally important, bridging the chronological gap between the medieval and modern periods often caused by truncation on other Perth sites. It also contains unusual and high-status imports, some previously unknown in Perth. The Ely wares can probably be linked to a citizen of Lynn in Norfolk, known to be living in the suburb (Hall, above), but otherwise it is surprising to find so much evidence of high status in what was all too plainly a scene of low life. A possible solution of this puzzle is that much of the assemblage may have arrived on site from elsewhere in Perth. The large open ditch would have been redund-ant and a nuisance, and easily converted to use as a public rubbish dump, filling up with the deep midden layers found during the excava-tion. An obvious source of high-status material would have been the Blackfriars a little to the west, a wealthy and influential institution under royal patronage, able on occasion to provide a meeting place for the parliament, and a lodging for the king himself.

The later phases of activity (Phase 5), with the well-defined tenement foundations along Castle Gable, corresponded closely with what was recorded on early maps from Rutherford 1774 onward. The large slab-covered culvert curving northwards towards the town's lade almost certainly supplied water to one of the mills shown in this part of Mill Street on the First Edition Ordnance Survey.

As always, the excavation has left us with some interesting questions for future research. We have partly confirmed the location and nature of the castle, but we still know nothing about its interior. It may be that the interior was to the east of the major ditch, and was totally washed away. On the other hand, perhaps it lay to the west, in which case it might appear in future work in the remaining car park and office buildings between the present site and Curfew Row.

Having identified the major ditch, we still know nothing about where it ends. At its southern end it probably joins the town defences, and this could be confirmed in future work under the former Pullars buildings on Mill Street. At its northern end it must either stop or turn, under North Port or the Blackfriars House Car Park. The landscaping works around the new Concert Hall were too shallow to reveal anything, but any major repaving or service renewal in North Port should reveal the continuation or the return of the ditch.

The anomalously early radiocarbon dates from the Phase 3 burials present an interesting problem. In the case of the St Laurence's Chapel burials, there is room for uncertainty, because the conflicting archaeomagnetic date for the Phase 2 hearth beneath is itself a little later than expected, and could be questionable. However, the murder victim in the pit is well-sealed, and the coins accompanying him seem securely dated, and once again suggest that the radiocarbon dates are a century too early. It is known that some of the upper layers of the site had been contaminated with fuel oil during the 20th century, but these layers had been removed before the excavation began, and there was no obvious evidence of such contamination on site during the excavation, for example soil staining or chemical smell. One might expect mineral contamination to produce wildly early dates, rather than the appearance of a moderate, consistent error. It is known that reliance on a predominantly fish diet can produce anomalously early radiocarbon dates, but it would be premature to explain the Horse Cross dates in this way without further evidence, for example from other contemporary burials in Perth.

The location of Perth's important medieval pottery industry continues to elude us, but the discovery of kiln props at Horse Cross suggests that it may one day come to light somewhere on the northern fringe of the burgh. The deep midden deposits over the ditch, and the unexpected character of the assemblages from them, suggest that early 'landfill' sites on the burgh edge may be important to complete our understanding of Perth and other burghs.

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Abstract
Excavation at Horse Cross in advance of Perth's new Concert Hall revealed evidence of Perth's medieval castle, the chapel of St Laurence with its burials, and the medieval and modern industrial suburb. Industrial evidence included tanning and metal working. The ceramic assemblage included imports from Yorkshire and Ely, and also from Rouen, Langerwehe, Malaga and Merida. Unexpected discoveries included a medieval bridge, and a 14th-century murder victim.

Keywords
bridge
castle
chapel
Ely ware
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Malaga ware
Merida ware
metal-working
murder
Rouen ware
Yorkshire wares

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