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A Cromwellian Warship wrecked off Duart Castle, Mull, Scotland, in 1653

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Chapter 10

HUMAN REMAINS

Human remains were first noted on the wreck by the Archaeological Diving Unit during their preliminary survey in 1992, and the iconic photograph of a carved wooden cherub taken at the time includes an ulna (Illus 118). Several exposed human bones were lifted during the subsequent recovery operation, and more were found during excavations between 1997 and 2003 (eg Illus 86, 128, 310). All were disarticulated and scattered among the deposit identified as the collapsed remains of the upper stern, and this has implications for the interpretation of site-formation processes at this part of the wreck (Chapter 4.2). At first it was assumed that the bones represented several individuals, but an examination conducted in 1999 by Professor Sue Black (Illus 311), showed that all derive from a single individual (Illus 312). Further finds since then have not altered this conclusion.

The only human casualties recorded in reports of the three shipwrecks off Duart Point in September 1653 were the 22 who perished aboard *Speedwell*. None is mentioned in association with the other two vessels wrecked, *Martha and Margaret* and *Swan*. As argued in Chapter 2.2, the latter seems to be the most probable candidate for the Duart Point wreck, so the evidence for an unrecorded fatality aboard this ship requires consideration. It raises the possibility that the wreck is not that of *Swan* but *Speedwell*, the only vessel on which casualties are positively stated to have occurred. However other evidence, including the royal associations of the Duart Point wreck and the origins of her ballast, militate strongly against such a conclusion. So too does the fact that only a single victim appears to have been involved. Had this indeed been the wreck of *Speedwell* the remains of some of the other 21 victims would surely have been identified.

There is something mysterious about the circumstances of this individual's death. Why was he below decks on a ship heading for disaster on a lee shore when every instinct should have brought him to the upper works, where the chances of survival and rescue would have been vastly greater? What was he doing in the stern area – possibly even in the great cabin – when he was (so far as we can judge) a common seaman? Might he even have been a prisoner under restraint? At any event the loss of a single and probably insignificant seaman, in the confusion of a catastrophic event, might well have passed un-noticed and unrecorded.

10.1 The human remains

Sue Black, May 2005

Skull (Illus 313–14)

DP99/022	Intact mandible with dentition
DP03/077	Fragment of left frontal bone
DP03/077	Fragment of left temporal bone
DP03/077	Fragment of left temporal bone
DP03/077	Fragment of right temporal bone

Illustration 310
Part of a human pelvis, as found on the wreck-site (DP 173954)

Illustration 311
Professor Sue Black studying the bones of Seaman Swan in the Granton Conservation Laboratory of National Museums Scotland in 1999 (DP 174691)

DP03/077	two fragments of right and left parietal bones
DP03/077	two fragments of right and left parietal bones
DP03/077	two fragments of right and left parietal bones
DP03/077	two fragments of occipital bone

Thorax (Illus 314)

DP99/033	Mesosternum
DP99/050	Right 1st rib
DP97/E003	Left 1st rib
DP92/045	Right possibly 4th rib
DP97/E002	Right 6th or 7th rib
DP92/180	Right 7th or 8th rib
DP02/025	Left 7th rib
DP92/013	Left 8th rib
DP99/015	Left 9th rib

Vertebral column (Illus 314)

DP99/024	2nd thoracic vertebra
DP99/014	4th thoracic vertebra
DP97/E001a	6th, 7th, or 8th thoracic vertebra
DP99/016	9th or 10th thoracic vertebra
DP99/024	11th or 12th thoracic vertebra
DP97/E001b	3rd lumbar vertebra
DP92/039	5th lumbar vertebra
DP00/057	Sacrum

Upper limb (Illus 314)

DP99/003	Right scapula
DP03/077	Right clavicle
DP00/060	Left clavicle
DP99/043	Left ulna
DP97/E004	Right 3rd metacarpal
DP02/025	Right 4th metacarpal
DP00/194	Left 5th metacarpal
DP02/025	Right 3rd proximal phalanx
DP00/037	Right 4th proximal phalanx

Lower limb (Illus 314)

DP97/E009	Right innominate
DP00/091	Left innominate
DP92/043	Left femur
DP00/120	Left tibia
DP92/279	Right fibula
DP92/064	Left fibula
DP99/034	Left calcaneus
DP00/130	Right talus
DP97/E006	Left 1st metatarsal
DP99/021	Left 2nd metatarsal
DP97/E005	Left 3rd metatarsal
DP99/026a	Left 4th metatarsal
DP99/026a	Left 5th metatarsal
DP99/034	Right 2nd metatarsal
DP99/026a	Left 1st proximal phalanx

Skull: mandible

The mandible (DP99/022) is intact, showing some post-mortem damage over the left condylar area, ramus and posterior aspect of the body (Illus 313–15). The remainder is well preserved, suggesting that the right side was buried deeper than the left, thereby preserving the surface. The bone is extremely robust and classically masculine in appearance although it is not very large. There are particularly well-developed sites of attachment for the masseter and medial pterygoid muscles which are involved in chewing. Mylohyoid, genioglossus and geniohyoid sites of attachment are also well developed.

Dentition

There has been post-mortem loss of most of the anterior teeth including both central and lateral incisors, both canines and the left 1st and 2nd premolars (Illus 315). These are single-rooted teeth and it is common for them to be absent from skeletonised remains. The remaining dentition therefore comprises all six molars and both right premolars. It can be said that all mandibular teeth were present and in occlusion, indicating an age at death in excess of 18–20 years. The molars show quite pronounced wear of the enamel with exposure to dentine apparent only on the first molars. Enamel polishing

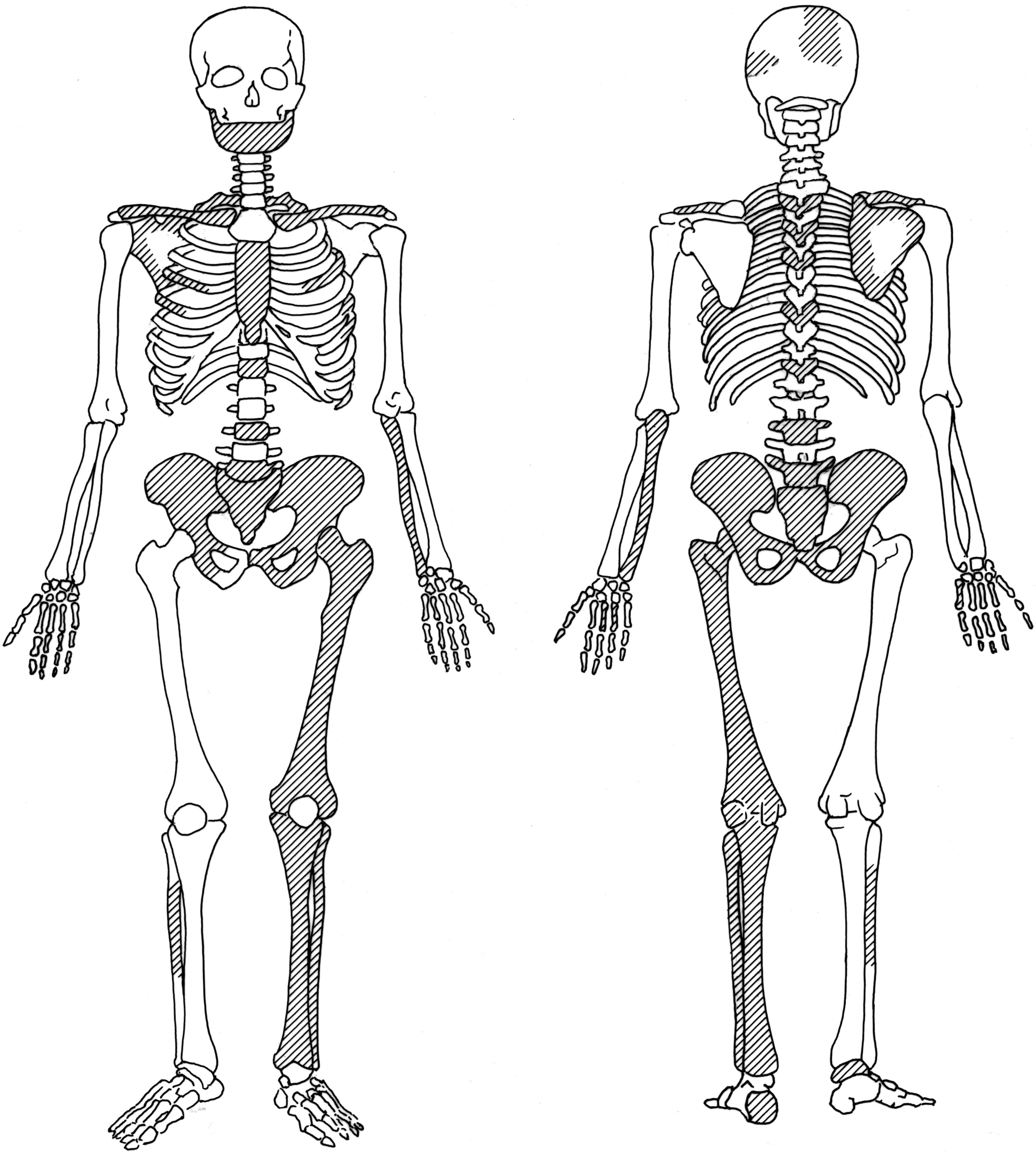

Illustration 312
Diagrammatic representation of the human bones found

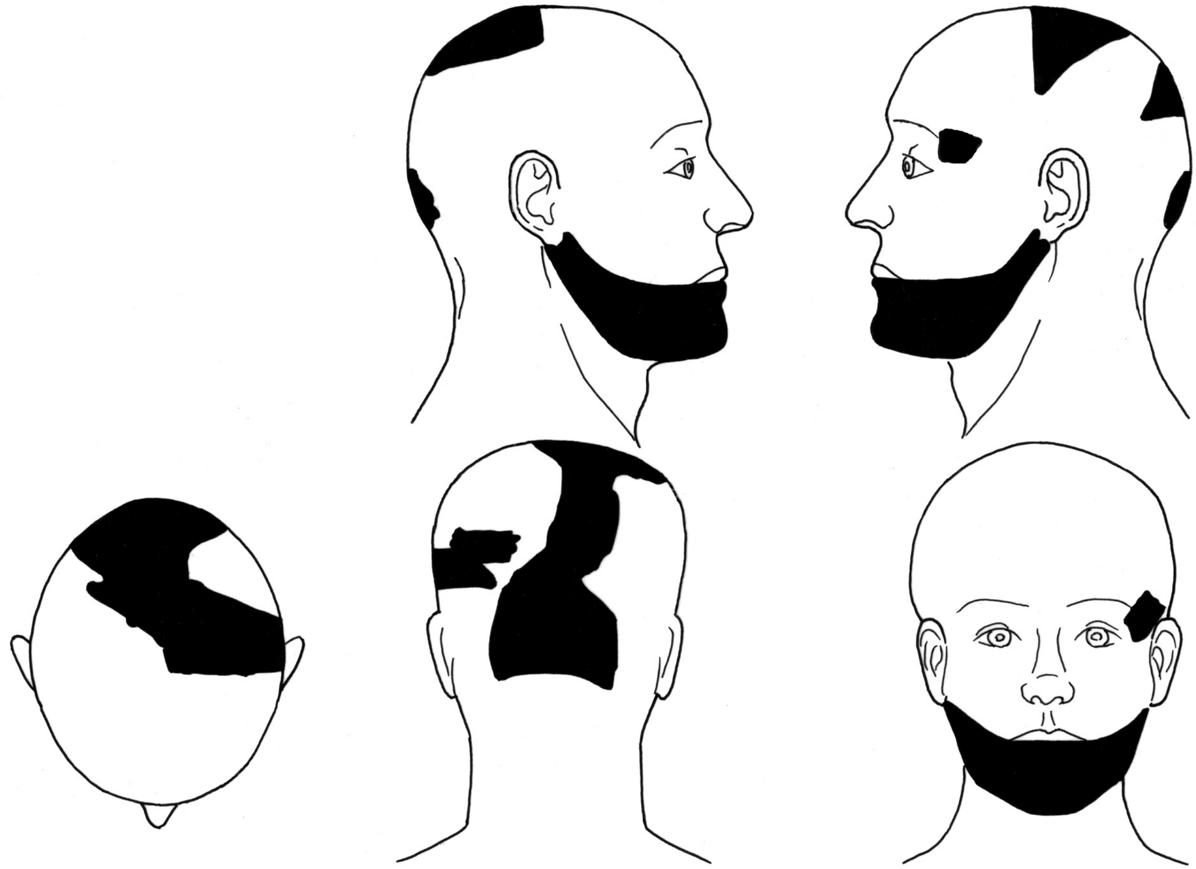

Illustration 313
Diagrammatic representation of the bones from the skull

Illustration 314
Diagrammatic representation of the bones from the rest of the body

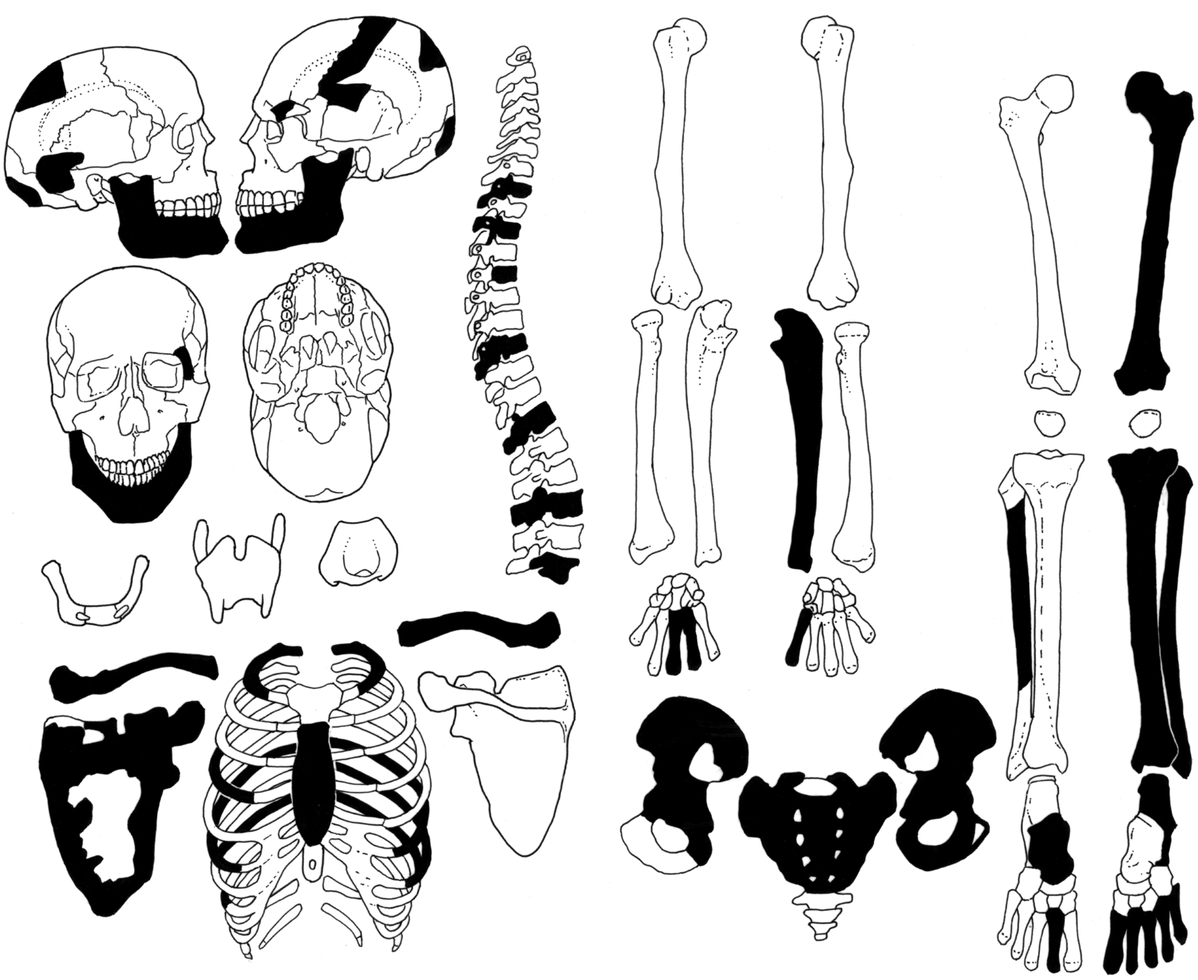

Illustration 315
Top: mandible and dentition as found. Bottom left: oblique view of mandible showing wear on teeth. Bottom right: mandible after removal of teeth for scientific analysis, exposing area of caries (DP 174146, DP 174064, DP 174063)

is present on all the molars. This pattern is consistent with an age at death younger than 25 years. The degree of wear is progressive from the 1st through to the 3rd molars and the pattern was symmetrical when the sides were compared. This indicates that all the maxilliary molars were present and in occlusion around the time of death.

A carious lesion is present on the distal surface of the right 2nd premolar and this can be seen in the dental radiograph (Black 2005: fig 2). There is a minimal build-up of calculus along the neck of each tooth and the alveolar bone looks to be in good health with a minimum amount of breakdown or porosity. The dentition suggests a robust adult male between 20 and 25 years old whose diet contained a heavy component of grit, probably stone-ground cereal. The distal root of the first left molar shows evidence of a granuloma which would cause no concern to the individual (Black 2005: fig 2). The 1st right premolar was removed, sectioned, and sent to Dr Wolfram Meier-Augenstein at Queens University, Belfast, for stable-isotope analysis. His results are presented below.

Skull: fragments

The 12 skull fragments (DP03/077), comprising only areas of the front, parietal, temporal and occipital bones, are illustrated in Illus 313. Three fragments could be bonded with confidence and formed the dorsal third of the right and left parietal bones (Illus 316). Two occipital fragments were also bonded. In summary the skull was relatively small and, from the presence

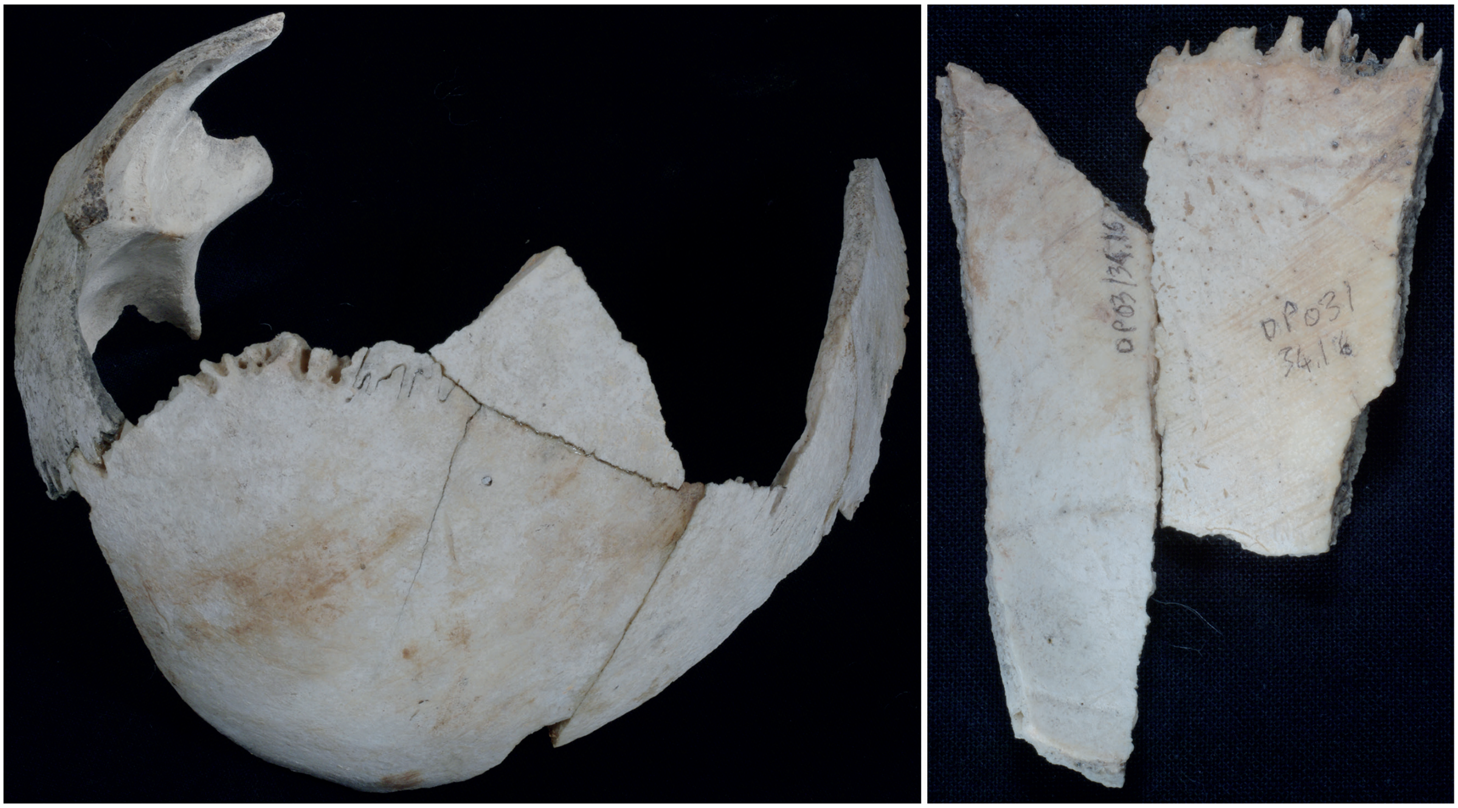

Illustration 316
Left: reconstructed skull fragments including the areas of the lambdoid and sagittal sutures. Right: conjoining skull fragments in the region of the occipital bone and lambdoid suture (DP 174062, DP 174065)

of an external occipital protuberance, was likely to be male. The open nature of some of the sutures, in conjunction with some evidence of endocranial closure, indicates a young adult. There was no evidence of pathology or trauma.

Thorax

(DP92/013, 045, 180; DP97/E002, 003; DP99/015, 033, 050; DP02/025)

Mesosternum

The mesosternum (DP99/033) is intact and shows not only completion of fusion between sternebra 1 and 2 but an absence of any residual lines. These have normally become obliterated by the age of 25 but the presence of sternochondral crevasses at the level of the 2nd and 3rd ribs indicates that age is most likely assessed as between 22 and 25. There is no evidence of either manubriosternal or xiphisternal fusion which corroborates age estimation to a limited extent. Radiography shows a mature mesosternum from a young adult (Black 2005: fig 5).

Ribs

Eight ribs were represented. While the first two in the sequence are readily identifiable, the fragmentary nature of the remaining six makes it difficult to establish their specific enumerations. However it is clear that four ribs from each side are present. All are adult, and show no evidence of epiphyseal activity, thereby indicating an age in excess of 22. Sternal ossification indicators of age indicated phase 2/3 activity which equates to an age at death of between 20 and 28.

The left 9th rib (DP99/015) displayed an absence of a tubercle for articulation with the transverse process of the 9th thoracic vertebra. This is a mirror of the picture portrayed in the possible 10th thoracic vertebra (DP99/016) where there was no corresponding facet on the transverse process. It is unlikely that this is a 10th rib as the head is not sufficiently horizontal, although the alteration in obliquity due to the higher positioning of the left ribs may account for this. These considerations suggest that in this individual the ribs on the left – certainly from the level of the 9th rib if not before – do not articulate with the transverse processes of the corresponding vertebrae. Little movement is possible at the costotransverse joint due to the tight binding nature of the ligaments, but it does allow slight rotational and gliding movements during respiration.

We can only guess as to the cause of this condition. It may have arisen due to a misalignment of the joint, probably during early development, or perhaps the congenital absence of a higher rib, or even intercostal fusion might have occurred. It is difficult to envisage the physical manifestation of such a condition and to appreciate whether there would have been any substantial alteration to thoracic stability, respiratory movements, and so on. In addition, this is a very broad rib for one occupying such a low position in the thoracic wall. In fact the supero-inferior depth of the midshaft region is significantly increased. This could be caused by the pull of the intercostal muscles that are being required to span a relatively wider intercostal space.

Vertebral column

(DP92/039; DP97/E001a, 001b; DP99/014, 016, 024; DP00/057)

Seven vertebrae are present, probably representing the 2nd, 4th, 6th, 9th and 12th thoracic and the 3rd and 5th lumbar. There is strong evidence to suggest that they belong to the same individual, although L5 is questionable. Although all the vertebrae have achieved adult status, the absence of the cortical shell on the ventral aspect of T2 (DP99/024) indicates recent maturity. Complete union of the vertebral epiphyses in the male occurs between 18 and 24 years. This therefore suggests that T2 is from an individual over 18 but probably under 25.

On the 4th thoracic vertebra (DP99/014) there is an unusual asymmetry with regard to the position of the articular facets for the tubercles of the ribs which begins at this vertebral level on the left side. The ribs on the left side of the body are carried slightly higher than those on the right. This can be deduced from the asymmetry on the inferior demi-facets for the head of the heads of the 7th ribs and this is mirrored by the position of the articular facets on the transverse processes for the tubercles of the ribs, being higher on the left.

For the 6th thoracic vertebra (DP99/E001a) there is some evidence of a slight vertebral endplate deformity on the right side of the superior surface. Recent research has indicated that such conditions are often the result of trauma at an age when the epiphyseal ring was still separate. The 9th/10th thoracic vertebra (DP99/016) also shows evidence of endplate deformities. While there is a possible site on the ventral aspect of the superior ring it is more obvious in the central area of the superior surface in a corresponding position. While these could be confused with Schmorl's nodes (herniation of the neucleus pulposus of the intervertebral disc) that on the inferior surface is more characteristic of a trauma-related endplate disorder.

As on the 4th thoracic vertebra, there is further evidence that the left ribs are carried higher than the right, primarily due to the position of the facets on the transverse processes, but also detectable in the facets on the lateral aspect of the vertebral bodies. In fact the tubercle for the 10th left rib does not appear to articulate at all with the vertebra, as there is no evidence of an articular facet on the transverse process.

As with all the previously described vertebrae, the 3rd lumbar vertebra (DP97/E001b) shows evidence of a well-defined endplate deformity (Illus 317). On the ring epiphyses

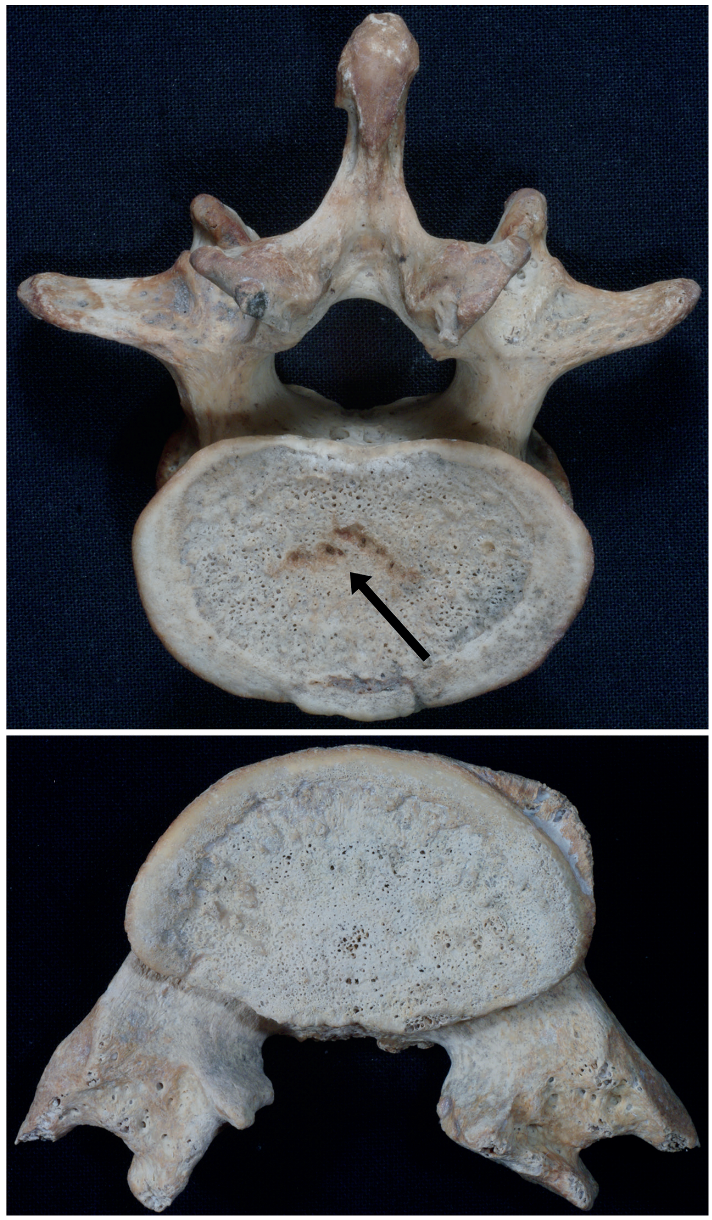

Illustration 317

Top: endplate deformity of the ventral aspect of the body of lumbar vertebra 3, with possible Schmorl's node in the middle of the body. Bottom: spondylolysis of lumbar vertebra 5. The posterior portion was not recovered (DP 174060, DP 174061) this has taken the form of an absence of the ring on the superior ventral aspect of the body, while on the inferior ring there is a discrete island of bone. This island also shows a build-up of bone along its ventral aspect, which could be indicative of a reaction to a previous trauma. The superior surface shows clear evidence of the vestiges of billowing, which would place an age-at-death estimate in agreement with the previous vertebrae. Schmorl's node is present.

The 5th lumbar vertebra (DP92/039) is damaged and does show some evidence of osteophytic development along the inferolateral aspect of the body. This may suggest that it is from an older individual, or it may be associated with the clinical condition present in this bone. The specimen shows a classic condition of spondylolysis, which is an ossification defect in the pars interarticularis portion of the vertebra (Illus 317). This results in the separation of the vertebra into two parts: a ventral body, pedicles and transverse and superior articular processes and a dorsal laminae, spinous process and inferior articular processes. In this specimen only the former is present, as the latter has not been recovered.

In adolescents and young adults this condition is rarely symptomatic, but with time the ligaments and muscles supporting this bipartite structure become strained and the ventral portion may slip forwards causing spondylolisthesis. The pain associated with spondylolysis and spondylolisthesis tends to be experienced as low back pain and stiffness, muscle spasms, sciatica or numbness. The condition is more common in males and can become symptomatic even in the young following strenuous activities. The incidence is 4–8% in a modern population. The cause of the condition is thought to be a defect in the cartilaginous anlage rather than the result of a traumatic incident, so there is likely to be a strong genetic component. Today, patients experiencing pain from this condition might be braced, and with bedrest and a cessation of strenuous activity the symptoms would subside. In more serious cases surgery might be advocated with L5–S1 arthrodesis. If this does indeed belong to the young adult represented by the previous vertebrae it is unlikely that he would have experienced any symptoms of the condition given his youth. However, with advancing years it is likely that he would have experienced pain and discomfort, and a modification of his lifestyle would have been the only option to relieve the symptoms, as no clinical alleviation would have been available. It is of course possible that the bone comes from a different individual who was somewhat older, but the fact that the skeletal collection includes no duplicates, and the general compatibility of the assemblage as a whole, suggests that this is unlikely. In any case the anterior vertebral margins are relatively sharp which suggests that even if this vertebra does belong to another individual, he was more likely to be in his 30s than in his 40s.

Illustration 318
The sacrum. The lines of fusion on the anterior aspect of the bone between S1 and S2 are clear, as is the patent line of non-fusion between S4 and S5 (DP 174055)

The sacrum (DP00/057) is complete although no coccygeal bones were retrieved (Illus 318). The bone is long and narrow with distinct male morphology including the extension of the sacro-iliac joint to the 3rd sacral vertebra. The bone articulates with the two innominates. Remnants of the S1/S2 junction indicate that the individual was younger than 33 and more likely to be around the mid-20s. The S2/S3 and S3/S4 junctions show completed fusion indicating an age of at least 23. Interestingly S4/S5 remains unfused but this is likely to be a developmental anomaly only. A slight articular disturbance is evident on the dorsolateral side of S1 and unusually small superior articular facets are present, confirming the spondylolysis diagnosis. The bone is not symmetrical but twisted, resulting in alae of a different length. This confirms the evidence of asymmetry located in the vertebrae and in the articulations of the ribs.

Upper limb

(DP97/E004; DP99/003, 043; DP00/037, 060, 194; DP02/025(2); DP03/077)

Right scapula

This (DP99/003) can be identified as an adult bone since the inferior angle has fused, as has the medial margin (Illus 319),

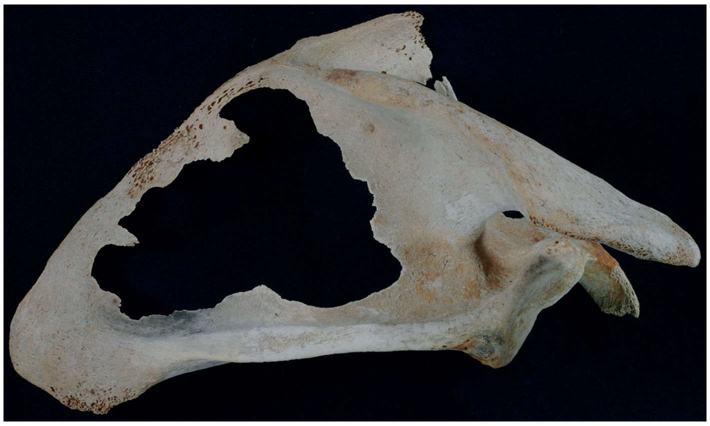

Illustration 319
The scapula was in a relatively poor state of preservation, but did show strong sites of muscle attachment (DP 174056)

which places the age at death in excess of 23. The thin areas of both the supra- and infrascapular regions have been lost due to erosion but the remainder of the bone is in relatively good condition. While the bone is not large, it is robust and shows some extremely well-defined regions of muscular attachment. In particular, the fossa running along the lateral margin of the subscapular fossa is very prominent. This is the site of attachment of the subscapularis muscle, which is a part of the rotator-cuff system of muscles and is responsible for medial rotation of the arm at the shoulder joint as well as being a stabilising influence on the joint. The remainder of the origin of this muscle cannot be examined, as the main body of the subscapular fossa is absent.

The site of attachment for the teres major muscle on the inferolateral aspect of the dorsal surface is also particularly well defined. Teres major is also a medial rotator of the humeral head. The well-developed crest that passes down the lateral border from the glenoid fossa represents the sites of attachment of the teres minor muscle (as with the subscapularis muscle, teres minor is a component of the rotator-cuff system that supports the head of the humerus in the shoulder joint). This is all indicative of an individual of relatively slight build who has particularly well-developed upper-limb musculature. There is evidence of a small impingement facet on the under-surface of the acromion. Unfortunately the head of the humerus has not been preserved, so we cannot predict the angle of the upper limb during this occupation to allow us to speculate on its origin.

Right clavicle

The clavicle (DP03/077) shows extensive sites of muscle attachment and an unusual degree of torsion. The site of attachment for the costoclavicular ligament displays a deep enthesopathy (Illus 320). The medial epiphysis has closed and

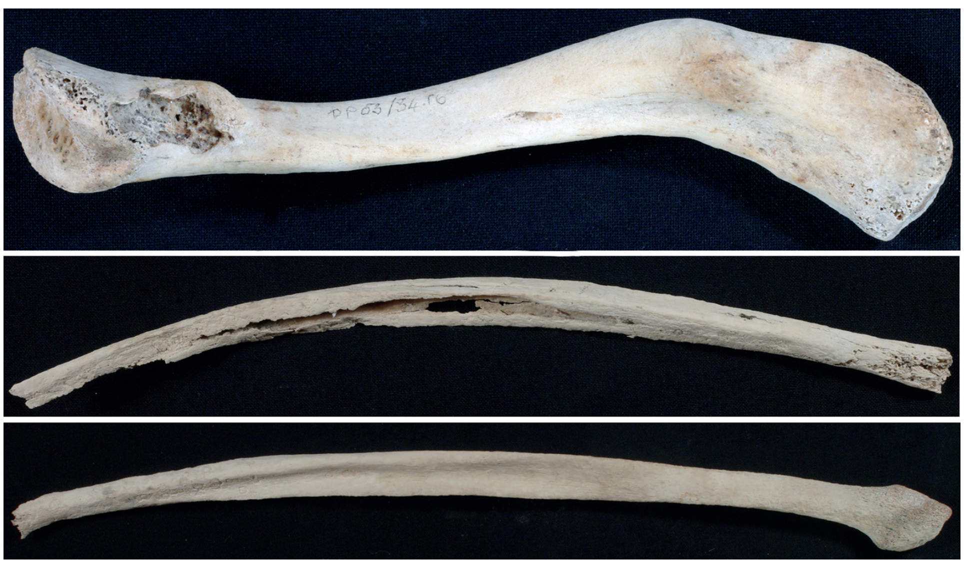

Illustration 320
Top: the clavicle shows strong sites of muscle attachment, and extensive cortical and medullary disruption at the site of attachment of the costoclavicular ligament. Centre: right fibula showing extensive post-mortem erosion. The bowing of the shaft seems somewhat accentuated because of the damage. Small circles were found imprinted on the cortex, presumably from the attachment of barnacles or similar creatures. Bottom: left fibula showing quite extensive bowing of the shaft. The interosseous border is well developed for sites of muscle attachment (DP 174057, DP 174058, DP 174059)

this tends to occur in the 20s. The left clavicle (DP00/060) mirrors everything seen in the right, indicating that the forces being placed through the clavicle as a result of strong muscle and ligament attachment are bilateral.

Left ulna

The bone (DP99/043) is intact and adult, as evidenced by epiphyseal closure, although a physeal indent is still visible on the olecranon process. The sites of attachment for the long flexors and extensors of the hand are particularly well developed, as is the site for the powerful forearm flexor, brachialis. Given the degree of robusticity it is most likely that the individual was male and the degree of muscle development suggests powerful arm and forearm musculature. A radiograph of the bone shows it to be normal with no evidence of growth-arrest lines to indicate serious episodes of childhood illness. Maximum length of the ulna was 253mm, which gives an estimated stature of *c* 1710mm ± 43mm (5ft 7in). It should be borne in mind that stature estimation based on the ulna has the highest standard deviation and is therefore the least reliable of all the long bones.

Metacarpals and phalanges

These were adult as evidenced by full epiphseal closure. They were small and relatively gracile but otherwise unremarkable.

Lower limb

(DP92/043, 064, 297; DP97/E005, 006, 009; DP99/021, 026a(3), 034(2); DP00/091, 120, 130; DP03/077)

Innominates

Right innominate (DP97/E009). The pubic bone is absent from this specimen (Illus 321). The bone is clearly adult, as the last vestiges of the iliac crest epiphysis have fused, indicating an age in excess of 23. The bone is male showing all the characteristic pelvic morphology of that sex, including greater sciatic notch appearance, shape of the iliac fossa and crest, and size of the acetabulum. Maximum acetabular diameter was recorded as 51.5mm which is small for a male but given the morphology of the innominate is not inconsistent with this attribution.

The sacro-iliac surface could not be used for age estimation as it was badly affected by post-mortem change. The acetabulum showed changes similar to those seen on the under-surface of the acromion consistent with an impingement facet. This suggests that the upward thrust of the femur has been sufficient to cause an irregularity on the articular surface of the acetabulum. While there is some post-mortem damage it is clear that there is a cortical disturbance on the dorsolateral rim of the acetabulum, possibly as a result of occupation-related movement or previous damage.

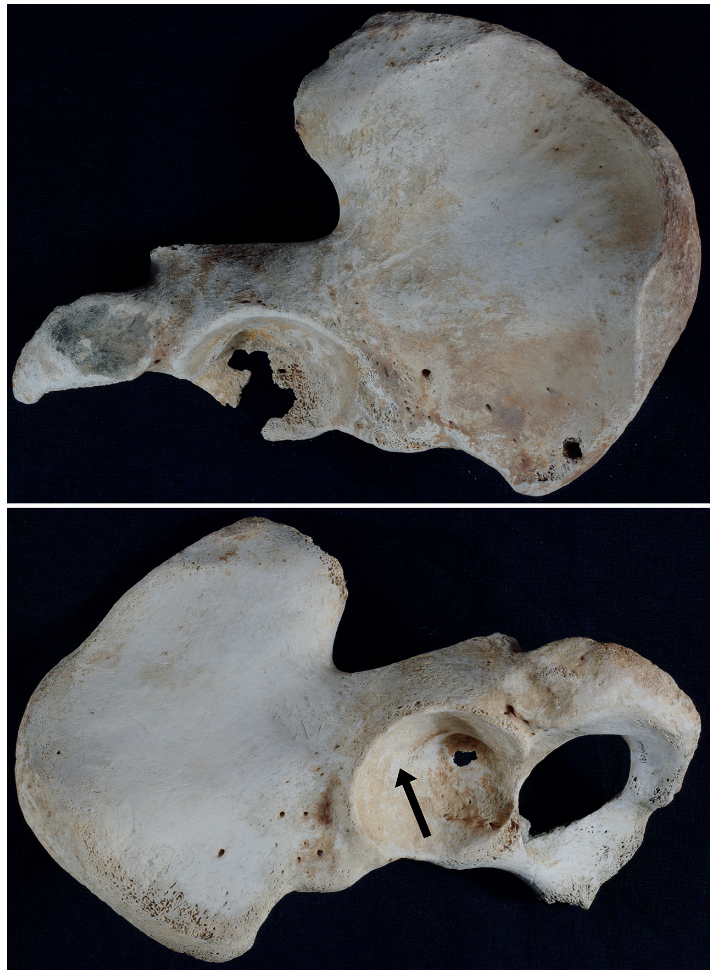

Illustration 321
Top: right innominate. The pubic bone is absent. The iliac crest is complete in terms of its fusion. Damage has occurred to the anterior aspect near the anterior superior iliac spine due to post-mortem damage where the bone has been pierced. Bottom: left innominate. The area of the impingement facet is indicated by an arrow (DP 174054, DP 174053)

The left innominate (DP00/091) was virtually intact (Illus 321). The epiphyses of the iliac crest were fused, suggesting an age at death in excess of 23. An impingement facet similar to that observed on the right innominate was located in the upper wall of the acetabulum. These impingement facets suggest a repeated upward translation of the femoral head to bring it into contact with the acetabulum. This condition is frequently seen in athletes whose sport involves landing on the lower limbs from a height, such as the high jump, long jump, and pole vault. Maximum acetabular diameter was 51.5mm, identical to that on the right side.

Long bones

The left femur (DP92/043) was neither particularly robust nor had particularly well-developed sites of muscular attachment.

However the site of the origin of the medial head of the gastrocnemius muscle in the popliteal fossa is moderately well developed. The maximum femoral-head diameter was 44.6mm which is clearly within the male range, and the maximum length is 442mm, which gives a calculated stature of 1680 ± 39mm (5ft 6in). The bone is adult as all sites of epiphyseal activity are closed. The head displays a slight impingement facet, superior and lateral to the fovea capitis, caused by an upwards displacement of the bone into its articular socket (see innominate above). A radiograph of the bone showed it to be normal with no evidence of growth-arrest lines to indicate serious episodes of childhood illness (Black 2005: fig 14).

The left tibia (DP00/120) is essentially complete and shows significant sites of muscle attachment. Metal deposits are present on the region of the medial epicondyle. The maximum length of the bone indicates a stature of *c* 1680 ± 34mm (5ft 6in), corresponding with the evidence of its associated femur. The proximal epicondylar breadth (70.5mm) and distal epicondylar breadth (48.5mm) are masculine but not robust. Tibial medial-lateral diameter at midshaft was 25.2mm, the tibial anteroposterior diameter at the nutrient foramen was 31.5mm and the mediolateral diameter at the same level was 25.5mm. These were all indicative, but not strongly, of male sex.

The right fibula (DP92/279) is in a particularly poor state of preservation (Illus 320). It represents only the central aspect of the shaft and shows extensive post-mortem damage to much of the cortex. Both proximal and distal extremities are absent. The bone is distinctly bowed in the midshaft area, which can be a strong indication of bone-deficit conditions such as rickets. Although this is generally considered to be a condition that arose during the Industrial Revolution, the symptoms have been noted on bones dating as far back as the Neolithic period. The condition arises through a deficiency in vitamin D, which manifests itself as an abnormal development of the bone precursor (cartilage). This irregular cartilage structure is then perpetuated when ossification of that structure begins. Therefore rickets is generally a disease of the young, which subsequently manifests itself in the adult as bowed long bones and is particularly prevalent in the lower limbs. It is of interest that in this individual there is no other evidence of rickets apart from the two fibulae, since it is unusual – though not impossible – for the fibulae but not the tibiae to be affected.

The left fibula (DP92/064) is represented by two parts: a shaft and distal extremity and a separate proximal extremity. The shaft shows a similar degree of bowing as seen in the bone above, so it is likely that they belong to the same individual (Illus 320). Although the bone is quite small it shows large sites of muscle attachment in the midshaft region. A radiograph of this bone shows no evidence of growth-arrest lines, again indicating no serious episodes of childhood illnesses.

Feet

The left foot is represented by a calcaneus, metatarsals 1–5 and the first proximal phalanx, while the right foot is represented by a talus and the 2nd metatarsal. The overall impression of the foot is that it would not have been particularly large.

The calcaneus (DP99/034) is intact and although not large it is robust. The peroneal trochlea on the lateral surface is particularly well developed with corresponding deep grooves for the peroneus longus and peronus brevis tendons. Full obliteration of the calcaneal epiphyseal line does not occur until between 18 and 20 years, indicating an age at death in excess of 20. All the metatarsals are adult as evidenced by fusion of the epiphyses. Apart from being small they are unremarkable.

10.2 Isotopic composition of human remains

Wolfram Meier-Augenstein, May 2005

Sections of one tooth (1st premolar) and of bone (femur and rib bone) were submitted to the Environmental Forensics and Human Health Laboratory for stable-isotope analysis.

Analysis

Trace-element isotope analysis

Subsamples of the above were sent to The Macaulay Institute (Aberdeen) for $^{87}Sr/^{86}Sr$ analysis (Table 10.1).

Light-element isotope analysis

Subsamples were prepared for ^{18}O-analysis of bone apatite using a modified protocol based on a published procedure (Stephan 2000) and precipitated Ag_3PO_4 was analysed for ^{18}O isotope composition by TC/EA-IRMS with the following results:

Femur CASS_2F = 16.7 ± 0.1‰ (vs V-SMOW)
Rib CASS_2R = 16.2 ± 0.2‰ (vs V-SMOW)

The samples were run in duplicate using a TC/EA (reactor temp 1400°C) coupled to a DeltaPlusXL isotope ratio mass

Table 10.1
Trace-element isotope analysis

Identifier	$^{87}Sr/^{86}Sr$	*%Sd Err*	*±2SE*
Femur Cass_1F Innerpart	0.709161	0.0018	0.000026
Femur Cass_1F Outerpart	0.709148	0.0016	0.000023
Rib Cass_1R	0.709142	0.0015	0.000021
Tooth Cass_1PM	0.709057	0.0016	0.000023

spectrometer and normalised to three standards: B1 (an in-house Ag_3PO_4, Alpha Aesar) and Tu1 and Tu2 (two Ag_3PO_4 standards from Dr T Vennemann, University of Lausanne) the 'true' values of which had been determined by fluorination methods at the University of Bradford.

Interpretation

It has to be stressed that this is probably the first time that archaeological human remains which have lain submerged in sea water for 350 years have been analysed for isotopic composition with a view to glean information on the geographic origin of a person (oxygen-isotope analysis was carried out on some teeth from the *Mary Rose* (Bell et al 2009). Due to the great potential for oxygen exchange between bone and sea-water as well as carbonate dissolved therein, and the unknown kinetics of these processes, great care must be taken when interpreting the results of ^{18}O isotope analysis of bone apatite. That said, in this particular case, the $\delta^{18}O$-values seem sound despite a distinct difference between rib and femur that, given the presumed age of this individual, seems to be the result of the aforementioned exchange processes rather than being caused by the different turnover rates of rib bone and femur.

Based on the ^{18}O from femur apatite (−16.7 ± 0.1‰) and Luz and Kolodny's correlation (1985) between ^{18}O of bone apatite and ^{18}O of drinking-water, the drinking-water consumed by this individual during his short life would have had a $\delta^{18}O$ value of −8.80‰ with a range of −8.67 to −8.93‰. In contrast, the same correlation yields a $\delta^{18}O$ value of −9.45‰ with a range of −9.19 to −9.71‰ for the $\delta^{18}O$ value obtained from the individual's rib bone.

There is no region in the United Kingdom with $\delta^{18}O$ values for precipitation or drinking-water of less than −9.00‰. However, there are two areas where $\delta^{18}O$ values for precipitation and drinking-water are less than −8.00‰ but greater than −9.00‰ (Illus 322).

However, the $\delta^{18}O$ values obtained from the rib bone are sufficiently close to those obtained from the femur to suggest that the difference as well as the more negative $\delta^{18}O$ value

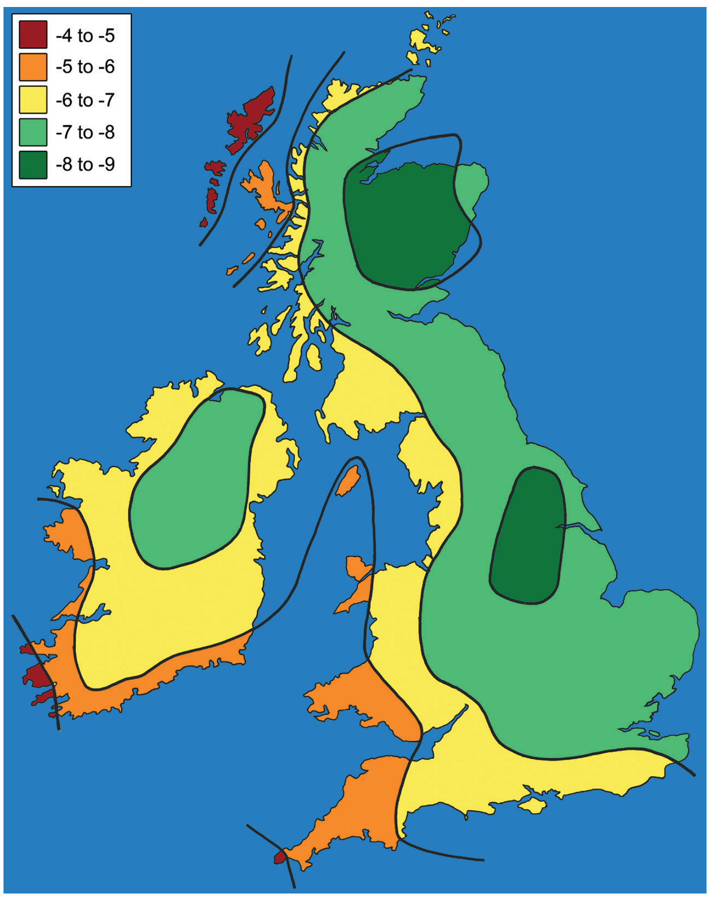

Illustration 322
Oxygen-isotope values for modern UK drinking-water (after a map kindly provided by NERC Isotope Geoscience Laboratory, 2004)

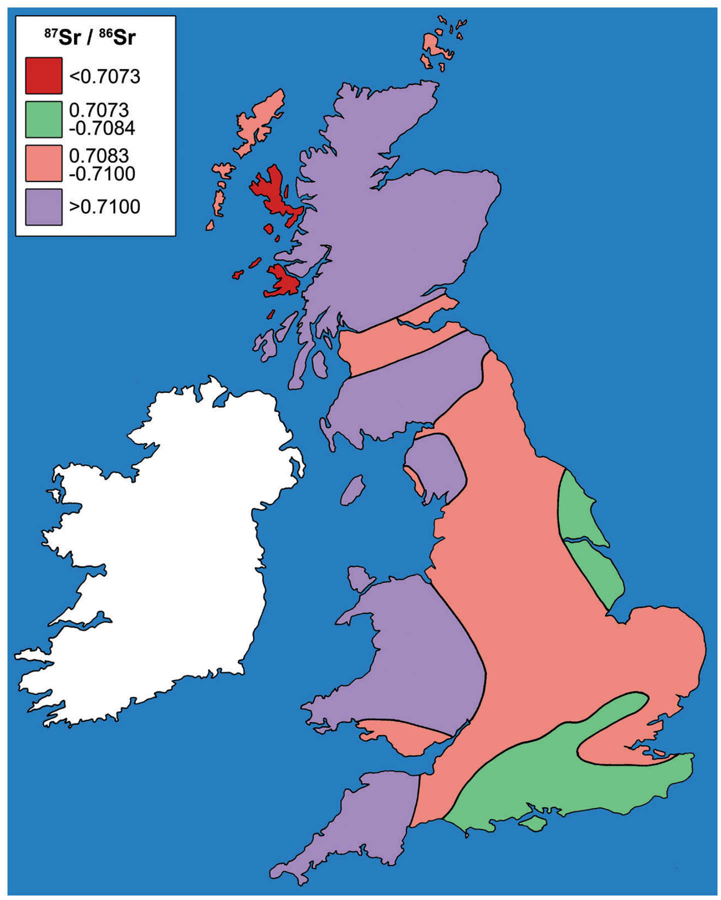

Illustration 323
Strontium-isotope values for modern UK drinking-water (after a map kindly provided by NERC Isotope Geoscience Laboratory, 2004)

could be caused by oxygen exchange with seawater, especially in conjunction with exchange via dissolved carbonate, since this type of exchange generally leads to a depletion in ^{18}O. Given the difference in thickness, density, and porosity between rib bone and femur, one could furthermore surmise the former to be more susceptible to this type of exchange than the latter. If, therefore, one used the lower end of the $\delta^{18}O$ value range for drinking-water gained from the femur as a geographical marker, this would put the individual's home either in an area enclosing York, Leeds, Doncaster, Sheffield and Nottingham, or in the Scottish Highlands, especially the northern part of Perthshire around Aberfeldy, Dunkeld, and Pitlochry, including parts of the Grampians such as Braemar and Ballater.

The above interpretation of the $\delta^{18}O$ values is supported by the findings of the strontium-isotope analysis, the results of which help to narrow down the Duart Point individual's geographic origins even further. The $^{87}Sr/^{86}Sr$ isotope ratios for all the sample materials fall in a relatively narrow range between 0.709057 and 709161. These values are consistent with the central part of the UK (Illus 323) and consistent with one of the two areas implicated by the ^{18}O-isotope analysis, namely Yorkshire. At the same time the observed range of strontium-isotope ratios rules out the Scottish Highlands, since the strontium-isotope stratigraphy here yields $^{87}Sr/^{86}Sr$ isotope ratio > 0.7110.

In summary, based on both ^{18}O and $^{87}Sr/^{86}Sr$ data from rib bone, femur, and 1st premolar it can be concluded that sufficient evidence exists to suggest that the individual concerned came from Yorkshire, specifically from an area circumscribed by Thirsk in the north, Sheffield in the south, York and Selby in the east, and Leeds and Bradford in the west.

10.3 Stable isotopic data analysis for rib and femur collagen

PETER DITCHFIELD, September 2012

The C/N ratios of 3.2 for both samples suggest that the collagen was in a good state of preservation. The values plotted (Illus 324) represent the mean of duplicate analysis. For the femur these are 11.11 per mil for $\delta^{15}N$ (AIR) and –19.91 per mil for $\delta^{13}C$ (V-PBD) and for the rib the values are 11.72 per mil for $\delta^{15}N$ (AIR) and –19.58 per mil for $\delta^{13}C$ (V-PBD), so there is

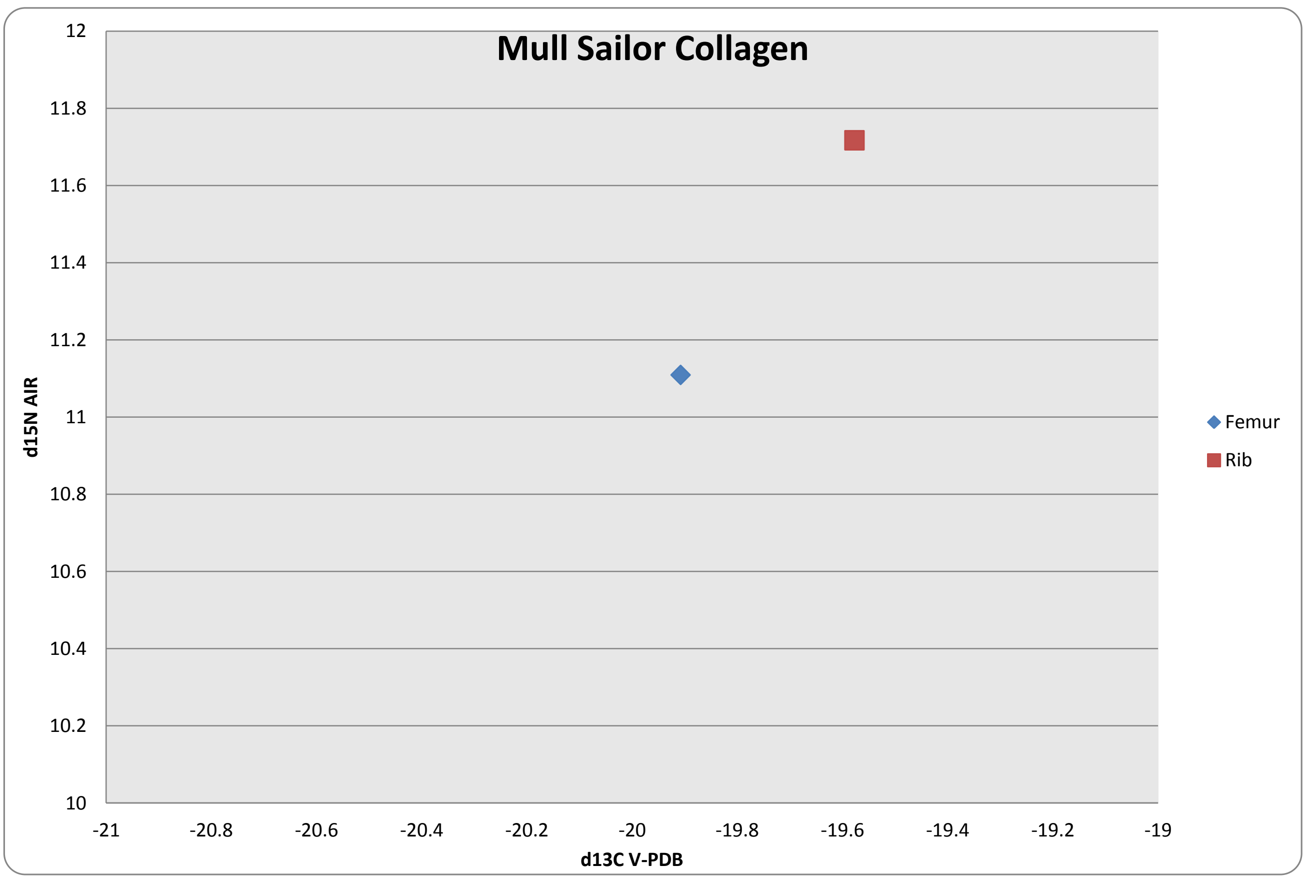

Illustration 324
Duart Point wreck sailor: rib and femur sampled in the first instance, given to JH for collagen extraction 07/06/12

a small difference between the femur and the rib. As this difference is somewhat larger than the difference between the values for the replicate analysis it may well be a real one.

In this case there is a shift towards less-depleted values of carbon and more-enriched values of nitrogen from femur to rib. As the rib collagen is likely to turn over more rapidly than that of the femur we might assume that the rib is more representative of later-life diet. The shift is quite small but nonetheless compatible with an increase in trophic position towards the end of the individual's life, possibly due to the incorporation of more marine resources in his diet with time.

Since the individual was quite young at the time of death, collagen was not sampled from the tooth as it would be unlikely to be different to that present in the femur. But given Dr Meier-Augenstein's findings based on the oxygen- and strontium-isotope analysis of the tooth enamel the shift seen in the bone collagen is compatible with a shift from an inland terrestrially dominated diet to one which incorporated some limited marine-protein resources such as might be included in shipboard rations. In this connection the presence of a substantial number of ling bones identified on the wreck may be significant (see Chapter 6.7). Nonetheless the protein component was still composed largely of terrestrially derived material, and this too is substantiated by finds from the wreck.

10.4 'Seaman Swan' in his contemporary world

Colin Martin

As excavators, recorders and specialist investigators, a number of people have come to feel a considerable affinity for the nameless individual who perished far from his home on 13 September 1653. Through the skill and dedication of Professor Sue Black and her colleagues we have come to know him not as a collection of bones but as a once-sentient person who lived in a world very different from ours. Their forensic wizardry, coupled with the archaeological investigation into the remains of his ship, have lifted a corner of the veil into that world, and what we have glimpsed has enlightened and enriched us in ways we could not have foreseen. It was a happy stroke of genius on Sue's part when, with respect and affection, she named this unknown young man 'Seaman Swan'. Over the years he has become a trusted informant and friendly presence as we have pursued our work among his bones and the remains of his ship.

Seaman Swan was born *c* 1630, probably on the eastern side of the Pennines between Thirsk and Sheffield, some distance from the coast. He was a slight, perhaps rather fragile child, though he suffered from no serious ailments apart from rickets. This condition is caused by vitamin D deficiency and lack of calcium, usually as a consequence of an inadequate early diet and dark living conditions. It is often associated with bad housing, poor hygiene, and breast-feeding by undernourished mothers. Rickets leads to a softening of the bones which characteristically causes bowed legs, a condition apparent in Seaman Swan's fibulae. It is not necessarily a disease of the poor – a generation earlier the sickly child who was to become Charles I suffered badly from it, fed inappropriately on curds and whey in the gloomy confines of Dunfermline Palace, in Fife (Keevil 1954: 409–10). But we may suppose that Seaman Swan spent his early years in poverty, perhaps in the dark hovels of a Yorkshire town such as Leeds or Sheffield, where industrial urbanisation was already stirring, or in York itself. It is less likely that he was a country boy, for in a rural environment he could have expected better access to the healthy food and sunlight that might have spared him the disease. Even so, that he survived at all in an age of high infant mortality suggests that there was an underlying resilience in his frail body. Evidence of rickets was also noted on skeletal material from *Mary Rose* (Stirland 2000: 88–9).

Around the time Seaman Swan was born, Charles I dissolved Parliament and attempted to rule without it for the next 11 years (1629–40), while his determination to establish an episcopal church in Scotland led to the so-called Bishops' Wars of 1639–40. These events probably meant little to the growing boy in Yorkshire, though he may have been aware that most of the area was in Royalist hands. However on 16 April 1642 Parliamentarians barred the gates of nearby Hull against the King, precipitating civil war. The Royalists remained dominant in Yorkshire until they were defeated by the Parliamentarians at Selby in April 1644 and at Marston Moor on 2 July, events of which young Master Swan would surely have been aware, even if they may not have affected him directly. The victors went on to capture York, and soon northern England was under their control.

By now our subject had reached adolescence and, although we cannot be certain, it is likely that around this time he went to sea. By the time of his death nine years later he had become an experienced sailor in his early 20s, following a skilled and physically strenuous calling which usually required entry in early adolescence. Whether from political conviction, or in hopes of bettering himself, or perhaps on a youthful whim, he left home and made for the coast – no doubt to the nearby Parliamentary naval base at Hull. His slight build and bowed legs may not have impressed the recruiting authorities, but he was wiry and agile and someone must have thought the navy might make something of him.

When he perished in the disaster off Duart Point on 13 September 1653 Seaman Swan was in his prime. Though his legs were bowed and rather weak his upper body had developed well, with strong shoulder and arm muscles, balanced on either side. This contrasts with the asymmetric muscle development which results from strenuous activities biased towards a master side – archery, for instance, or championship tennis (Stirland 2000: 123–30). A balanced muscular profile, on the other hand, is indicative of rhythmic, synchronised strenuous activity, such as weight-lifting or rowing. Like his fellow sailors, Seaman Swan would have been nurtured as a carefully programmed mobile power-source, able to apply co-ordinated motive energy through his muscles to the simple machinery which harnessed the wind and regulated the management of the ship – hauling on ropes, setting and adjusting spars and sails, heaving on oars, operating the whipstaff, manning the pumps and windlass, scrubbing the decks and working the guns. The routine performance of these duties would have developed the muscles and general fitness levels evidenced by Seaman Swan's anatomy, which also suggests that he had enjoyed an adequate and reasonably balanced diet, including meat, fish, and much stone-ground cereal as the extensive tooth-wear shows. This, it may be suggested, does not necessarily reflect humanity on the part of the Cromwellian authorities, but a practical realisation that seamen were engines of motive power essential to the working of the ship, and had to be kept in good condition.

That he was a topman who regularly worked aloft is indicated by the impingement facets caused by repeated upward thrusting of the femur onto the acetabular roof. It is still a practice on square-riggers, after working aloft, to slide down the mainstay or shrouds, dropping the last few feet onto the deck (Villiers 2000: pl 20). Working in the confined waters off western Scotland, Seaman Swan would probably have performed this action many times each day.

We may suppose that Seaman Swan was one of a party left on board the ship when her main company came ashore after anchoring in Duart Bay. What brought him to the stern-cabin area when she was cast adrift during the storm of 13 September 1653, and why he was still there when she struck Duart Point, we will never know. This anonymous casualty of a long-forgotten conflict has now been laid to rest in consecrated ground outside Duart Castle, overlooking the site of his wrecked ship.