Society of Antiquaries of Scotland

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

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Chapter 8

OTHER FINDS AND RELATED ACTIVITIES 1

8.1 Navigation

It is unlikely that the Duart Point ship, which appears to have operated mainly if not exclusively off western Scotland and around the Irish Sea, would have been equipped for long-distance open-water voyaging or global position-fixing (Taylor 1956; Waters 1958). No evidence has been found on the wreck of instruments such as the cross-staff or astrolabe, used for measuring the altitude of the sun to determine latitude. Nor is there any equipment to suggest the practice of dead reckoning, which involved running out a line pulled by a wooden drogue, or log-ship, in the vessel's wake over a timed period (usually half a minute) to calculate speed through the water (Taylor 1956: 201; Bingeman 2010: 98–103). This, together with routinely recorded compass headings and regular observations to determine latitude, allowed the ship's progress to be estimated and its positions plotted sequentially. Had such procedures been routine aboard the Duart Point ship it is probable that traces of the distinctive equipment required – instruments for measuring altitude, logs and lines, tabulated slates for recording observations (or traverse boards, which served a similar purpose), and sand-glasses for timing – would have survived among the collapsed interior of the stern, where a substantial cache of more basic navigational equipment suitable for coastal voyaging has been found.

These include the remains of a binnacle, parts of three mariner's compasses (one substantially intact), three compass-box lids, and two pairs of dividers. In 1991 or 1992, before the site was designated, a sounding-lead was found on the wreck by a casual visitor, though exactly where is not known. These items suggest that traditional pilotage techniques were practised on board, as would be appropriate for a ship in regular visual contact with the distinctive inshore sea-marks which characterise the confined waters of Britain's western seaboard. Detailed local knowledge of landforms, havens, anchorages, tides, and currents would have been a navigator's primary assets in such an environment. To find his way around this juxtaposition of sea and land he would have needed to know only where he was with reference to known sea-marks, his ship's heading, the depth of water under the keel, and the character of the sea-bed. This information could readily have been be obtained with compass and lead-line alone (Hutchinson 1997: 164–9), and both have been found on the Duart Point wreck.

The binnacle

88 DP96/004, **002.015/011.014**, the remains of a wooden box-binnacle lay just below a semi-mobile surface layer within an isolated deposit some 10m north-east of the aft part of the main wreckage (Illus 63). The rear part of a box-like structure of pine now measuring 930mm × 430mm × 122mm (Illus 224), it is fastened with square-sectioned oak pegs 14mm long and 4mm square at the top, tapering to a point, which suggests that they were hammered in like nails. Seven components (or parts of them) survive. Two rear planks 14mm thick are edge-joined with an overlapping rebate, and held together by side pieces 3mm thick. One of these remains in place, while peg-holes on the opposite side indicate a similar arrangement. The rear planks are tangentially derived, and tool-marks indicate that they were trimmed to a constant thickness with an edge which has left a slightly concave signature. A 30mm plank spans the side pieces, and can be identified as the top of the box from the burn-marks discussed below.

Slots cut into the top plank house the remnants of two internal panels, 10mm thick, dividing the box into three compartments. The two outside compartments are *c* 0.3m wide, suggesting that the intended measurement had been one English foot (0.305m), while the central compartment is 0.2m (8in) wide. A 0.1m-diameter aperture is cut through the rear of the left-hand compartment. The purpose of this hole is unclear, though it may have provided draught-free ventilation for a light in the adjacent central compartment. In the upper right-hand corner of the left compartment lay the lead-ballasted wooden base and brass pin of a mariner's compass 78. That the assembly had extended below the second transverse rear plank is evident from a rebate cut along its lower edge to receive a third plank. Unlike the rebate in the

88

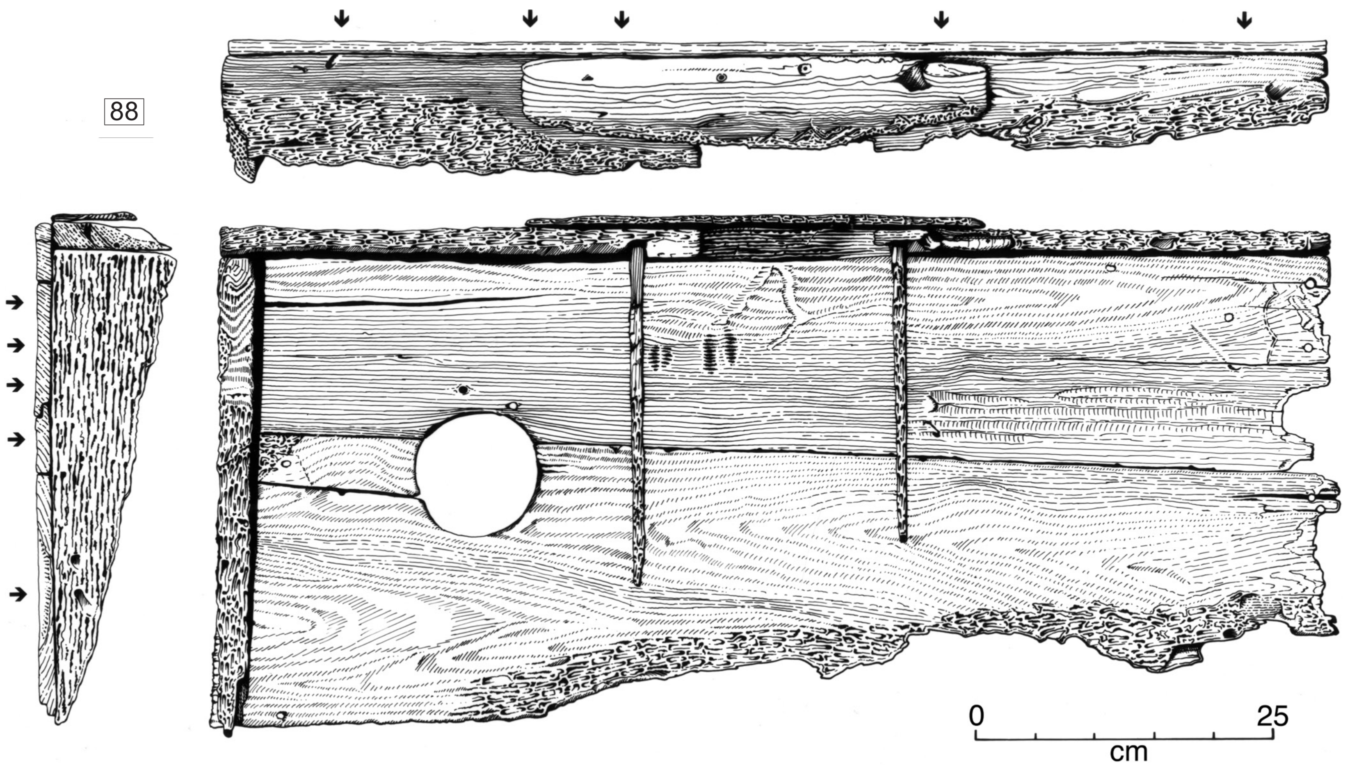

Illustration 224
The remains of the binnacle 88, showing the relationship of its components. Arrows indicate the locations of the oak pins (Peter Martin, DP 174865)

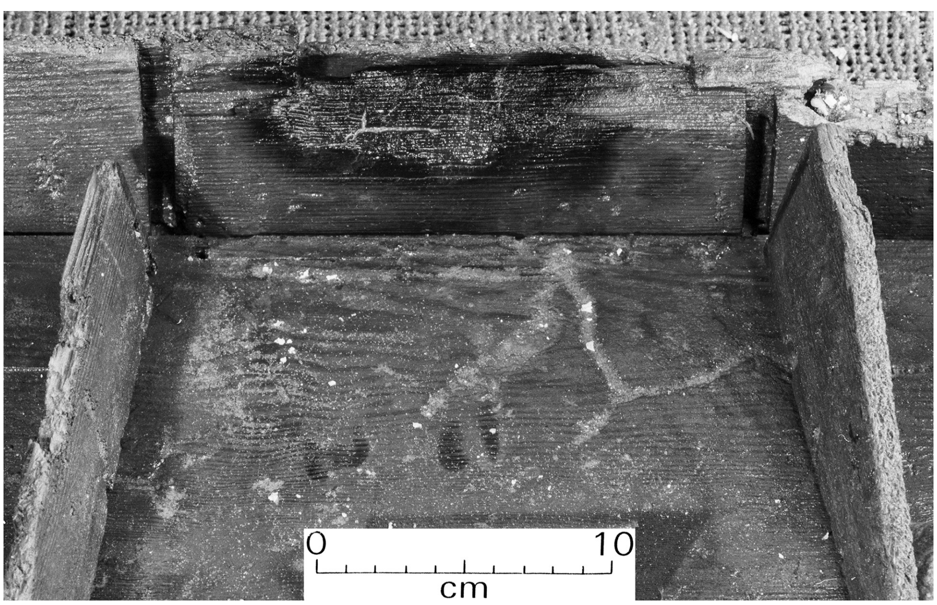

Illustration 225
Detail of the binnacle's central compartment, showing the burnt hole in the top plank and the repair patch. Four small scorch-marks can be seen within the compartment (DP 173211)

top plank, which is lapped externally to throw water from the joint, the second was lapped internally, which would have rendered it prone to water ingress from the outside and consequent rot. This was probably a mistake, perhaps reflecting inexperience on the part of the maker.

These structural characteristics, together with the associated compass-base, unambiguously identify the object as the rear part of a binnacle, or bittacle, of the type described by Sir Henry Mainwaring in his *Seaman's Dictionary* of *c* 1620–3 (Manwaring & Perrin 1922: 98–9):

> A Bittacle is a close cupboard placed in the steerage before the whip or tiller, wherein the compass doth stand, which is not fastened with iron nails, but wooden pins, because that iron would draw the compass so that it would never stand true. These

> are to be so contrived, that they may carry a candle or lamp in them to give light to the compass, so as they dispense no light, nor yet any be seen about the ship.

John Smith (1627: 11), confirms these arrangements: 'before him [the steersman] is a square box nailed together with wooden pins, called a bittacle, because the iron nails would attract the compass. This is built so close, that the lamp or candle only showeth light to the steerage'. The etymology of the word has been discussed by Waters (1955: 198–9), who notes a shift in usage from 'bittacle' to 'binnacle' during the 18th century. While the latter term is therefore technically an anachronism when applied to the Duart Point find, it is used here for clarity.

Traces of burning on the back of the central compartment confirm that it had housed a flame, presumably from a candle or lantern (Illus 225). Four small scorch-marks are evident on the back of the compartment, while a slightly irregular hole with burnt edges some 0.12m across penetrates the top plank. The direction of burn indicates that this plank had faced upwards when the mishap occurred, confirming the orientation of the binnacle as interpreted above. It may be supposed that an inattentive steersman had allowed the illuminating flame of the candle or lantern inside to burn through its top. The damage was roughly repaired with a wooden patch secured with iron nails. The use of such nails is contrary to the strictures of Mainwaring and Smith, who rightly identify iron fastenings in a binnacle as a cause of magnetic deviation, and specify the use of wooden pins throughout. It is noteworthy, however, that both authorities failed to recognise the greater errors inherent in placing two magnetic needles so close to each other. The provision of a compass at either end of the binnacle was intended to give the steersman at the whipstaff clear sight of one from whichever side of the deck he happened to be standing (Lavery 1987: 26). This arrangement must have caused significant inaccuracies because of the mutual attraction of the needles.

This type of three-compartment binnacle is illustrated by Falconer (1780: pl I, no 4) (Illus 226 top), who describes the object as

> a wooden case or box, which contains the compass, log glasses, watch glasses, and lights to shew the compass at night … The Binacle is furnished with three compartments, with sliding shutters: the two side ones always have a compass in each, to direct the ship's way, while the middle division has a lamp or candle, with a pane of glass in either side.

This arrangement is shown in a watercolour of a view from the poop of the warship *Deal Castle*, painted in 1756 (reproduced in Lavery 1987: 26). Falconer notes that two binnacles were provided on warships, one for the steersman and the other for the officer of the watch. However a small vessel such as the Duart Point ship probably contained only one, positioned immediately forward of the whipstaff.

Early binnacles from archaeological contexts are rare. An upright box-binnacle was found in a wreck believed to be that of the Basque whaling ship *San Juan*, lost in Red Bay, Labrador, in 1565 (Grenier et al 2007: 147–9). It too had burn-marks inside, and iron nails had been used in its construction. One of the compass-boxes found on *Mary Rose* (1545) was also fastened with iron (Stimson 2005: 269–70). The undesirability of iron in the proximity of compasses was evidently not appreciated in the 16th century.

It appears that three-compartment binnacles came into use around the beginning of the 17th century (Lavery 1987:

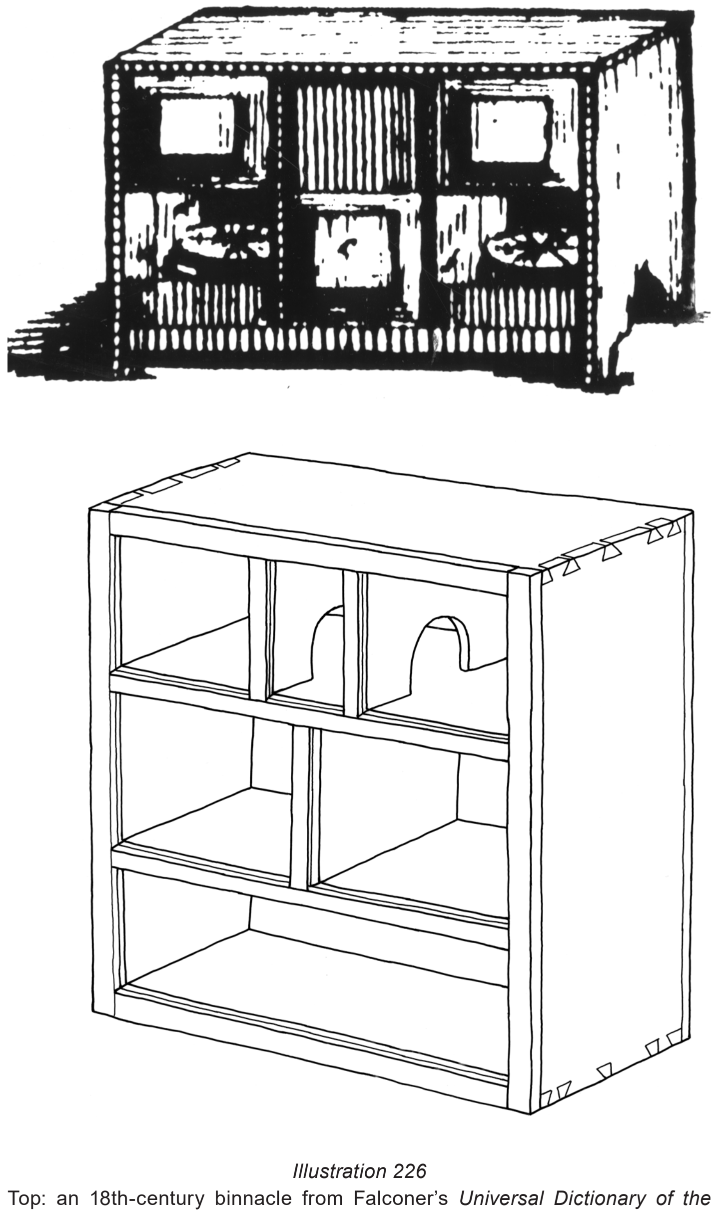

Illustration 226
Top: an 18th-century binnacle from Falconer's *Universal Dictionary of the Marine* (1780). Bottom: a reconstruction of the Stinesminde binnacle of *c* 1640 (after Gøthche 1994: 184, fig 7)

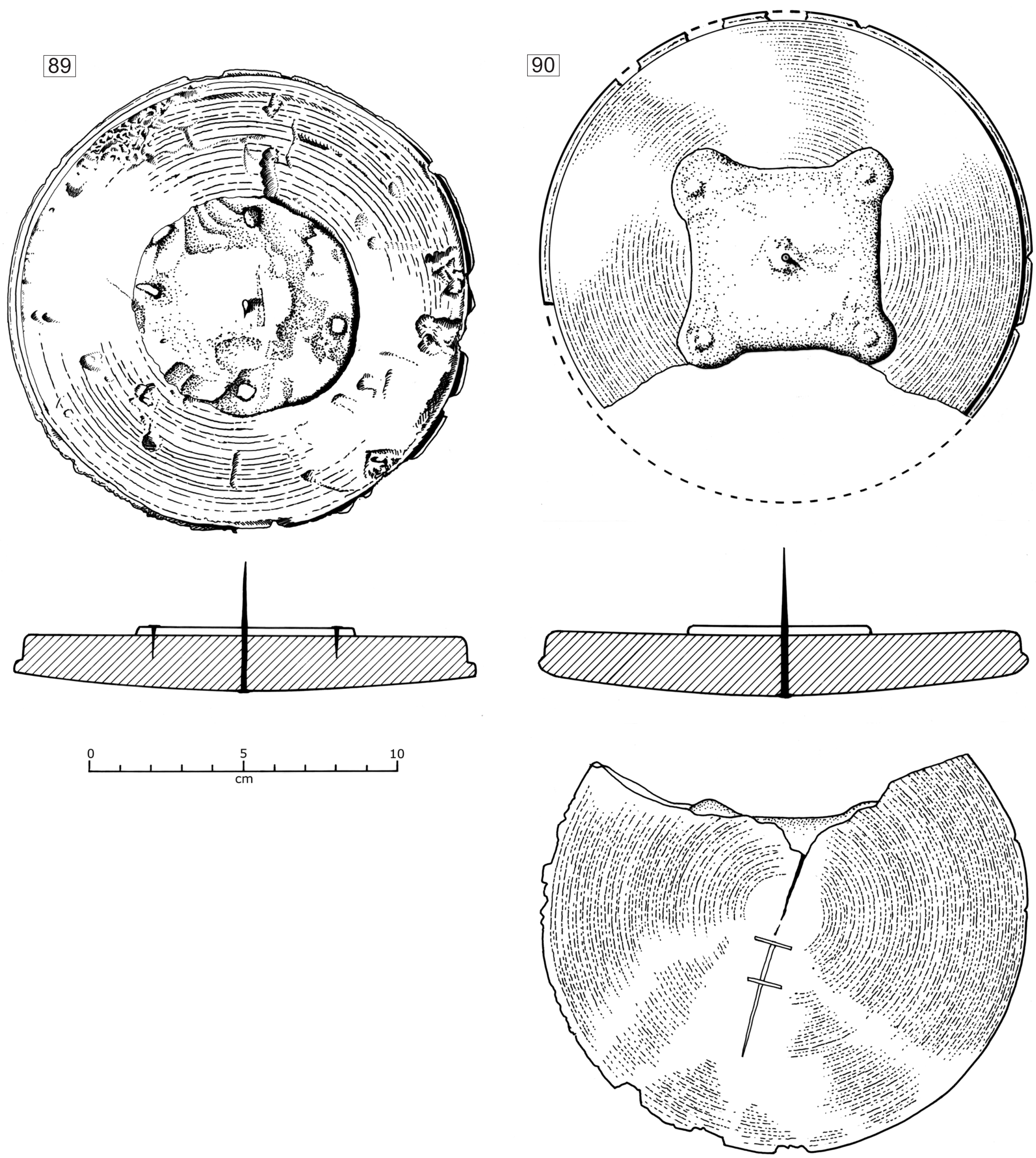

Illustration 227
Left: compass-base 89, found inside the binnacle. Right: compass-base 90, showing a crack in the base repaired by the insertion of two copper-alloy dogs

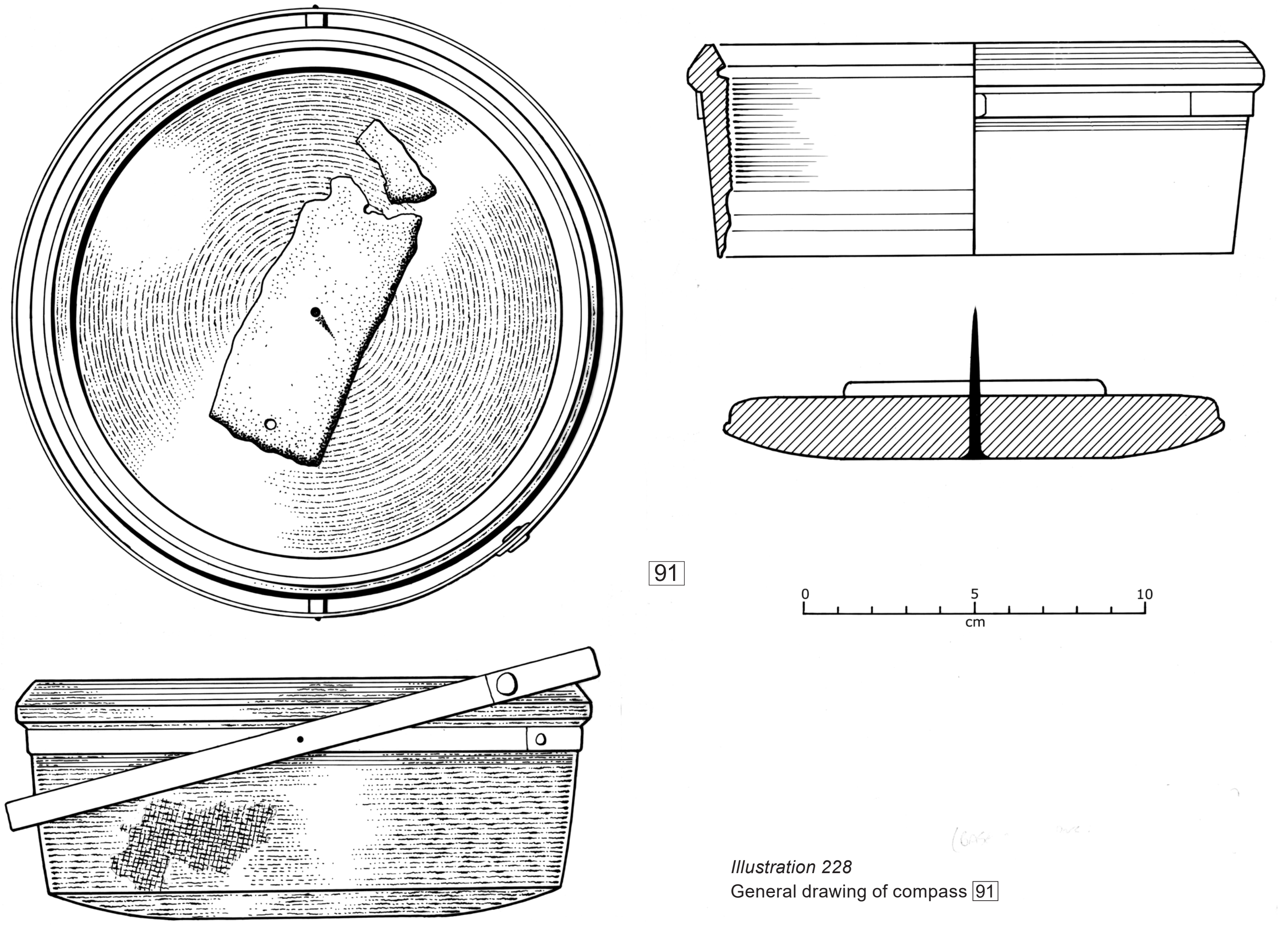

Illustration 228
General drawing of compass 91

26). This supposition is supported by the present find, and by the identification of a similar and more intact binnacle on the Stinesminde wreck off north Jutland, which has been dated to *c* 1640 (Gøthche 1994: 184, fig 7). The Stinesminde binnacle is of pine, and consists of an open-fronted box with a base and two shelves (Illus 226 bottom). Its top shelf is divided into three compartments of which the central is the narrowest and the outer ones are equal, as on the Duart Point example. Two semi-circular cuts in the partitions allow light to pass from the central compartment onto the compass faces. It is likely that the lower shelves provided stowage for charts and associated navigational equipment. The incomplete Duart Point binnacle was probably of similar form.

Mariner's compasses

Waters (1958: 26–9) has described the construction of the mariner's common sea-compass of early modern times, based on Richard Eden's 1561 translation of Martin Cortes's *Arte de Navigar* (1551). The description accords closely with the Duart Point instruments, the characteristics of which are discussed below.

89 DP96/003, **009.013**, compass-base, 150mm (6in) in diameter (Illus 227). The turned base of a mariner's compass in poplar was found inside the left-hand compartment of the binnacle 88. The bottom is slightly rounded, and its lower rim is finished with a semi-circular bead. A 70mm-diameter lead ballasting-disk has been nailed to the middle of the base with four broad-headed copper-alloy nails, to dampen the instrument's movement from the horizontal as it swung on its gimbals. The pin on which the needle rotated is also of copper alloy, driven through the centre of the base to protrude 24mm above its upper surface.

90 DP00/016, **093.106**, a partly broken compass-base was found beneath Gun 8 82 (Illus 227). Like compasses 89 and 91 it was turned from poplar, with a diameter of

Illustration 229
The bowl, gimbal-ring, and base of compass 91. Note the patch of fabric adhering to the bowl near the bottom left (DP 173338, DP 173339)

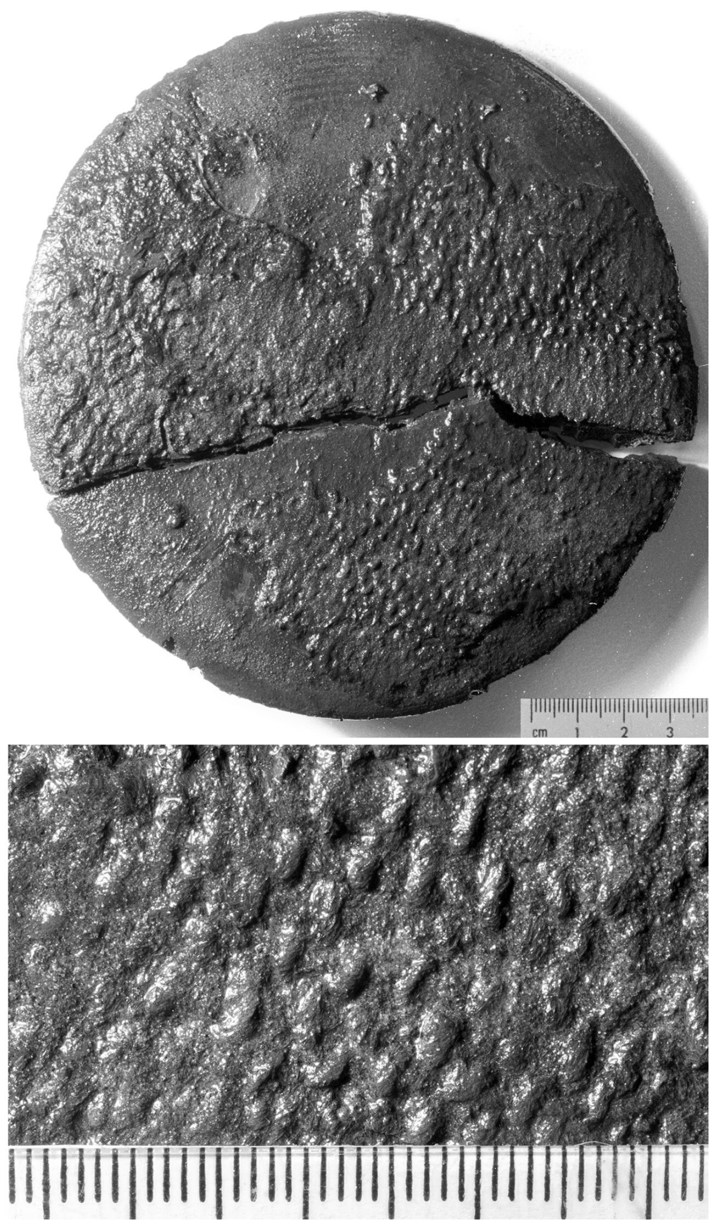

Illustration 230
Top: the underside of the base of compass 91, showing the remains of the fabric sleeve. Scale in centimetres (DP 173336). Bottom: detail of the fabric weave. Scale in millimetres (DP 173340)

160mm, and was the largest of the group. It is of similar design, with a beaded lower rim and rounded bottom. A square lead ballast-weight has been hammered at the corners to create rounded tabs by which it is fixed to the base with four copper-alloy nails. The central copper-alloy pin passes through the base and extends 30mm above it. A serious crack in the base has been repaired (or possibly a manufacturing imperfection concealed) by the insertion of two almost-invisible copper-alloy joiner's dogs.

91 DP97/A050 (base) (DP97/A051) (glass) and DP97/A035, **060.095**, excavation some 10m inshore from the binnacle complex revealed another mariner's compass (Illus 228–30). The 170mm-diameter compass-bowl is turned from poplar, as is the 150mm-diameter base. Its height of 65mm is about half the presumed diameter of the missing card or 'fly', the proportion ascribed by Waters (1958: 26–9) in his description of the European mariner's sea-compass from the 16th century onwards. Its thickened rim, of flattened triangular section, is grooved on the inside to accommodate the glass face, which was sealed with resin, traces of which survive. A copper-alloy strip 8mm deep and 0.15mm thick encircles the rim immediately below its shoulder, its overlapped joint fixed with a flat rivet. This would have strengthened the compass-bowl, locked the glass face, and provided opposing pivot-pins for the copper-alloy gimbal-ring. The gimbal-ring itself, 180mm in diameter, remains in place. It too is joined with a rivet. Two 3mm holes set 90° from each of the gimbal pivots are provided for mounting the ring on pins inside a missing outer compass-box.

The separate base is similar to that of 89 and has the same diameter. Fixed to it is a rectangular ballasting-piece of lead, much degraded by electrolysis, no doubt stimulated by the proximity of the copper-alloy fittings. A copper-alloy pin thrusts through the base, extending 28mm above it. The method by which the base was secured to the compass-bowl is of particular interest. As on 89's base, its lower edge is finished with a bead of semi-circular section. This is designed to fit snugly into a slightly tapered seating at the bottom of the compass-bowl, with the bead forming what is in effect an 'O-ring' seal. There are no other fastenings. The base, together with its compass-card and attached iron needle, could thus easily be removed. This would have been necessary at intervals to reactivate the needle by stroking the iron with a lodestone or, as contemporaries engagingly put it, 'feeding' the compass (Waters 1958: 27–8).

The tapered seating arrangement would have prevented the base, once inserted, from moving upwards into the bowl. It would not, however, have stopped it from dropping out. This was evidently prevented by encasing the bottom and sides of the compass-bowl in a tightly fitted cloth sheath, parts of which still adhere to its base and sides (Illus 229–30). Although this method of securing the base might seem unnecessarily elaborate, it reveals considerable sophistication of design. The compass, secured at the top with a face of resin-sealed glass and at the bottom with a ring-seal held in place by a fabric sheath, would have been absolutely watertight. Just how effective this arrangement was is indicated by the fact that when the compass sank to the equivalent of one extra atmosphere above ambient pressure it was the wooden base, and not the seals, which ultimately failed to withstand the differential.

The account-book of James Forrester, a skipper from Prestonpans near Edinburgh, contains four undated entries between 1687 and 1690 for 'dressing the compasses and glasses' (Hustwick 2000: 100–23). It may be presumed that this involved checking the compasses and sand-glasses, and reactivating the magnetic needles. The number of entries over a four-year period suggests that this was an annual operation, while the fact that the transactions were listed in the expenditure accounts suggests that these specialist tasks were not undertaken by the crew but required the services of an outside contractor. The same document records the purchase of 'a new bittikell' for £4 Scots, while a further 16s was paid for horns 'for the same' (Hustwick 2000: 111). The latter were probably translucent panels for the lighting compartment.

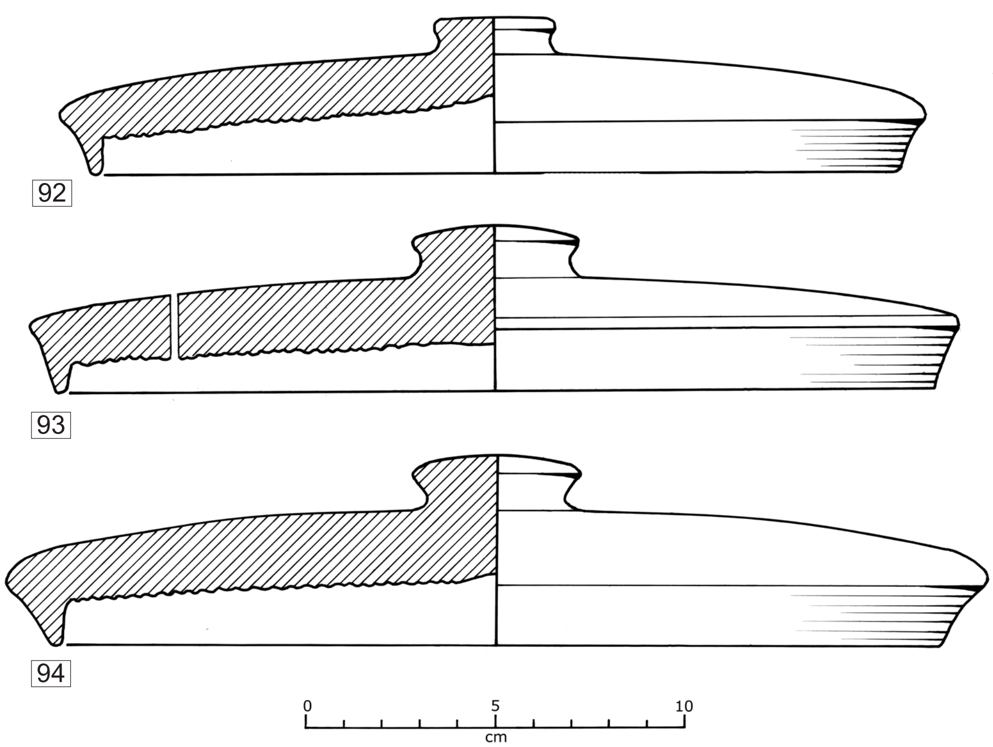

Illustration 231
The compass-box lids 92–4 (DP 174867)

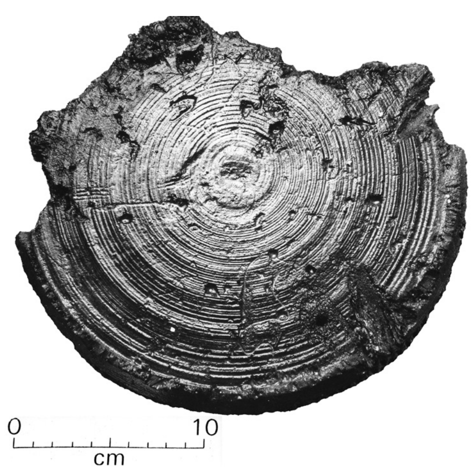

Illustration 232
The underside of compass-box lid 92 showing evidence of turning with a coarse gouge and the rough removal of the central spigot (DP 173401)

Note on the fabric

Janet Shelley

This report is offered in the light of a visual examination conducted in advance of conservation, and without the opportunity of identifying the fibre or disassembling a sample of fabric to confirm the structure of the weave. It should therefore be regarded as a provisional statement, suggesting various possibilities which may be elucidated as the conservation procedures progress.

The remains of a double or single textile structure are clearly visible on the base and sides of the compass-bowl. The diagonal pattern of the material suggests the possibility of a twill fabric (Illus 230). However, as only one element of the structure is prominent (it could be either the warp or the weft), it is probably an unbalanced twill of warp- or weft-faced type.

Both twill and loosely woven plain-weave structures would have had sufficient elasticity to cover the base and sides of the compass without creating awkward bulk, rather in the manner of a jampot cover or 'clootie dumpling'. The bias distortion of the weave created by stretching would also enhance the diagonal appearance of the cloth. Greasing the fabric might have been employed to improve the fit. How it was held in place around the compass-bowl is not clear. The brass band around the upper part might have been used to secure it, but this seems unlikely since the band appears to have been permanently riveted in place, and in any case no fabric appears to have been trapped behind it. As far as can be seen from the sample, the yarn appears to be rounded and loosely spun, and is possibly linen 'tow' of a kind widely used throughout Europe. The finest quality linen (line) was only used for household linen and apparel.

Compass-box lids

92 DP96/005, **009.109**, immediately adjacent to the binnacle, and at the interface between the mobile surface shingle and stabilised substratum, was a turned wooden lid with an upstanding central knob and an inwards-tapered rim, 250mm in diameter (Illus 231). It is made of poplar. The top surface is smoothly finished but its underside, which would not normally have been visible, has been roughly turned with a deep gouge and no attempt made to conceal the spigot-scar at the centre (Illus 232). A hole has been drilled towards one side in the manner of a bread-crock, perhaps to avoid an air-lock. It may be surmised that the lid belonged to a turned box of matching diameter, into which the compass bowl would have been secured by the holes in its gimbal-ring. The diameter suggests that its purpose was to contain one of the compasses associated with the binnacle, into which the assembly would have comfortably fitted. Turned compass-boxes with similar lids have been found on the wreck-sites of *Mary Rose* (1545) (Stimson 2005: 267–71) and *Kronan* (1676) (Johansson 1985: 129, 215).

93 DP99/045, **074.104**, compass-box lid, 260mm diameter (Illus 231).

94 DP99/074, **082.102**, compass-box lid, 230mm diameter (Illus 231).

Deep-sea sounding-lead

95 DPnd/001, location unknown, sounding-lead, weight 6.94kg (15.3lb), length 372mm, width at base 60mm (Illus

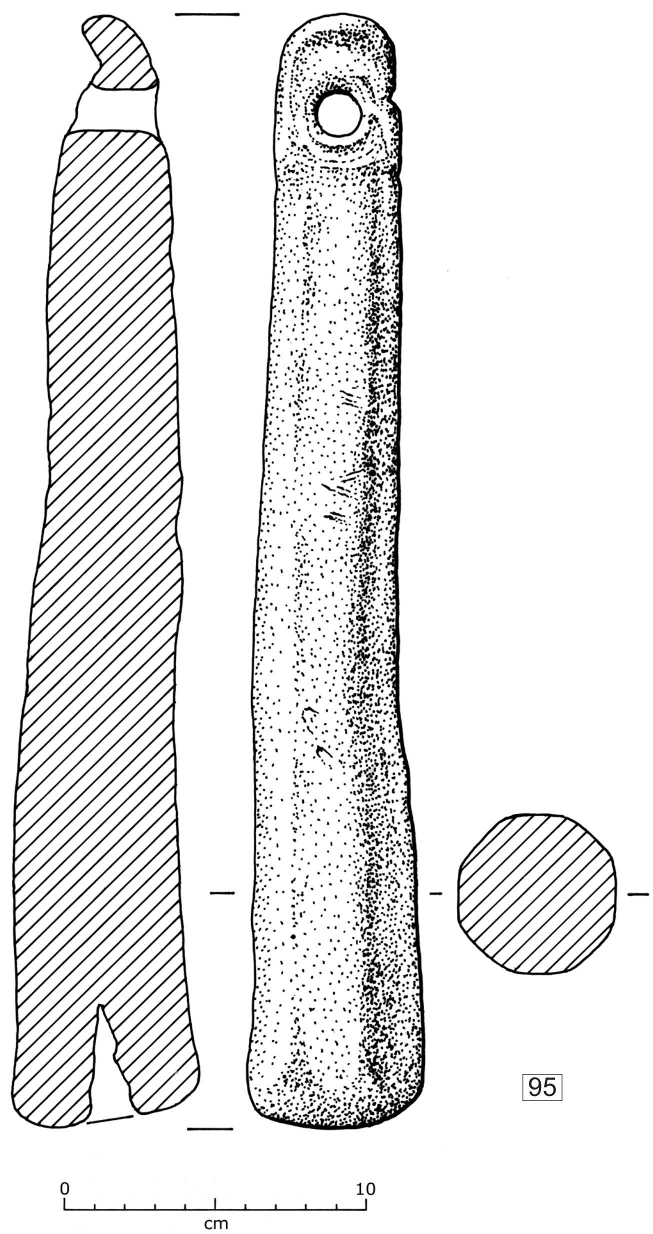

Illustration 233
Deep-sea sounding-lead 95 (DP 174869)

233). A deep-sea sounding-lead, reported as having been recovered from the site in 1991 or 1992, was anonymously returned to Historic Scotland in 2011, and passed to National Museums Scotland for accession in the Duart Point collection. Without knowledge of its context there is no absolute certainty that it is associated with the wreck, but its form and condition, together with the circumstances of its discovery, leave little doubt of its provenance. It is of octagonal cross-section with a lug at the top and a 15mm diameter suspension-hole. An irregular arming recess 15mm in diameter on the surface penetrates 35mm into the base, where it ends in a point. Various cut-marks on its surface do not appear to represent numerals, and may well be accidental.

Such objects are common on post-medieval shipwrecks, and a close parallel comes from what is probably the wreck of *Ann Francis*, lost in 1583 on Margam Sands, Swansea Bay, South Wales (Redknap & Besly 1997: 200–1). The Margam example is inscribed with the Roman numeral XIII, and weighs 6.1kg (13lb 4½oz). It is 358mm long and 58mm diameter at the base. Mainwaring *c* 1623 specifies 14lbs as the common weight of a deep-sea lead. It was used with a 100- or 200-fathom line with the first mark at 20 fathoms and at 10-fathom increments thereafter (Manwaring & Perrin 1922: 229). A 7lb lead on a heavier 20-fathom line marked at more frequent intervals was used for sounding in shoal waters. Both types were provided with a hollow which could be 'armed' with tallow to obtain a sample of the sea-bed encountered by each cast. In most cases this is a shallow depression in the base, the narrow conical recess in the head of the Duart Point lead being unusual. It is suggested that a mushroom-shaped piece of tallow was used, its stalk thrust into the arming-hole so that the bulbous head would squash on impact, picking up a good sample of the ground.

Navigator's dividers

96 DP00/132, **106.083**, copper-alloy navigator's dividers, 158mm long, 60mm across the bow (Illus 234).

97 DP00/177, **101.083**, copper-alloy navigator's dividers, 164mm long, 60mm across the bow (Illus 234).

Found among the remains of the collapsed stern, they are both of the so-called 'single handed' type; that is, the upper parts of the two legs form interlocking double bows below the hinge so they can be adjusted between the palm and fingers of one hand. They are of similar but not identical design, and suggest the use of charts on board.

8.2 Hand-weapons and related finds

Powder-boxes

Four powder-boxes or -flasks were recovered from the collapsed stern area (Illus 235–6). These cylindrical wooden

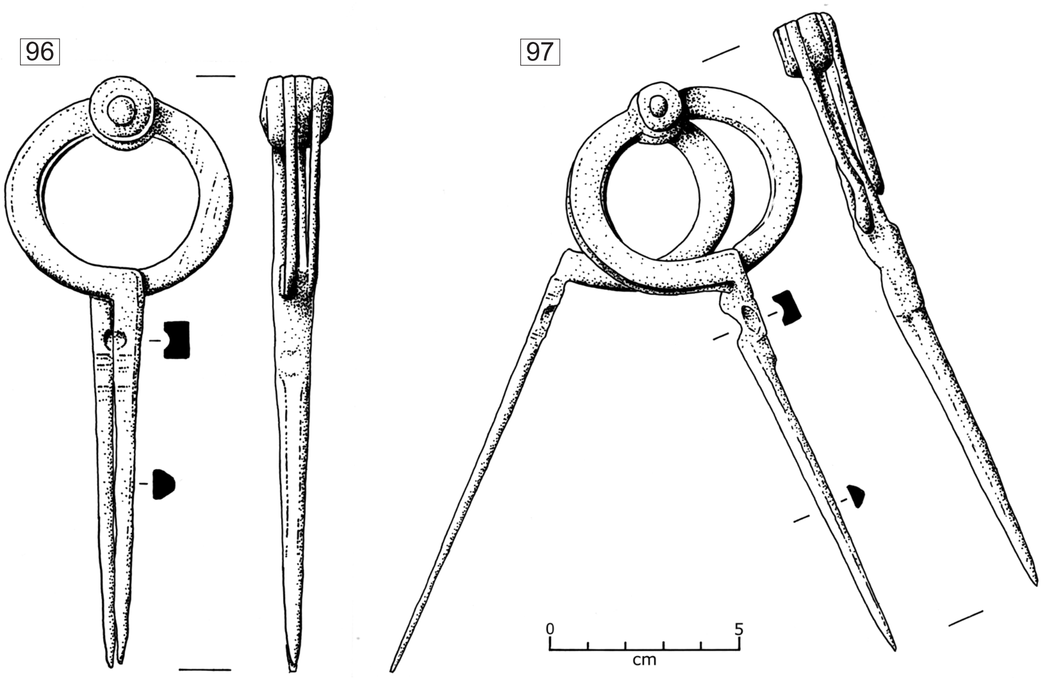

Illustration 234
Copper-alloy navigator's dividers 96–7 (DP 174870)

Illustration 235
Examples of turned wooden powder-boxes (DP 174349). Scale in centimetres

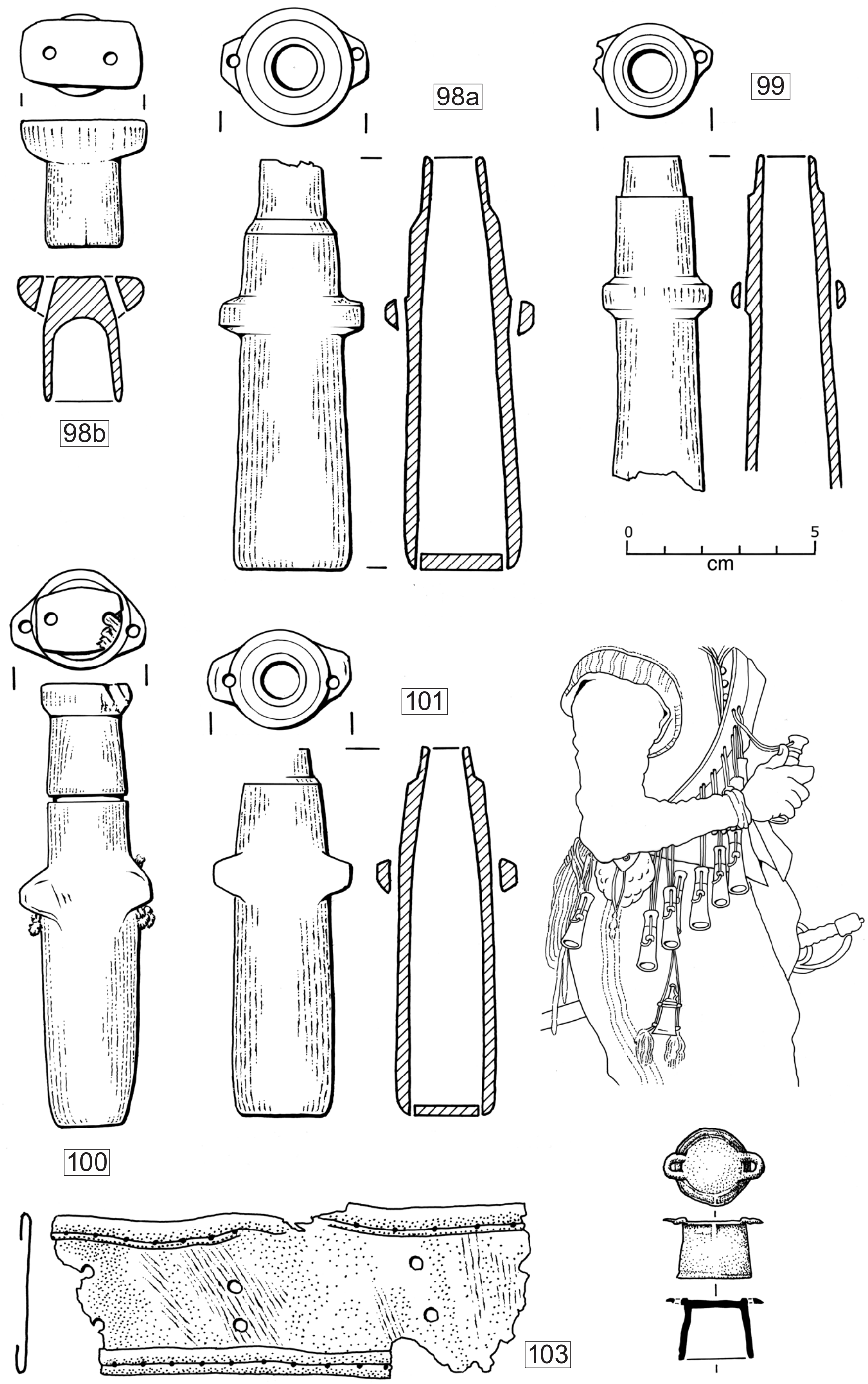

Illustration 236
Drawing of turned wooden powder-boxes 98–101 (DP 174833). Bottom left: leather fragment with hemmed edges and paired holes 103, identified as part of a musketeer's bandolier. Centre right: detail of a musketeer's bandolier and powder-boxes (after de Gheyn 1608: engraving 23). Bottom right: lead powder-box cap from Tantallon Castle (after Caldwell 1991: illus 5 no 40)

Illustration 237
Seventeenth-century musketeer's equipment demonstrated by a re-enactor (DP 174351)

containers would have hung from a musketeer's bandolier or crossbelt (Illus 236–7), and were designed to hold a single pre-prepared charge of gunpowder which was tipped into the upturned muzzle during the loading sequence. A set of 12 was normally carried.

98a DP00/166, **111.085**, intact turned sub-conical powder-box, its main body 109mm high extending to 120mm with the lid in place (Illus 235–6). It has a 31mm-diameter base blocked with a plug 4mm thick. The sides are a fairly constant thickness of between 3 and 4mm, rising to a shoulder 90mm above the base where the thickness reduces to 2mm forming a tapering spout 15mm deep and 18mm in diameter. The interior volume of the box is 25cm^3, which allowing a weight/volume figure for packed gunpowder of 1.5g/cm^3 gives a charged capacity, if filled to the top, of 37g (1⅓oz).

98b DP00/079, **111.075**, powder-box cap (Illus 235–6) fits the above.

This suggests that box 98 was designed for the larger category of lead bullets identified in the Duart Point sample, the 12-bore calibre at *c* 19mm diameter, which weighs *c* 43g (1½oz) (see Foard below). This powder/shot proportion is considerably greater than that prescribed by Sir James Turner in his *Pallas Armata* of 1683, that 'a musket requires the half weight of her ball in fine powder and two thirds of common powder' (Firth 1992: 81). This may suggest that powder-boxes of this size were intended for 12-bore muskets, that the powder was of 'common' grade, and that they were not filled to the brim. The space at the top might have held a twist of wadding, where it would have been conveniently to hand when required.

The spout would fit comfortably into a musket-calibre muzzle, making it easy to insert, empty, and withdraw. The cap is topped with a flat T-piece to facilitate grip, through which two 2mm-diameter holes for cords slant outwards. The body of the box has two matching lugs below the shoulder, formed by leaving a ring on the carcass during turning on a lathe and subsequently trimming off the excess. These lugs are also drilled with 2mm-diameter cord holes.

The method of hanging the boxes on a bandolier is shown in a number of contemporary illustrations, notably the set of engravings by Jakob de Gheyn published in 1608, showing in sequence the full drill for loading and firing a musket (Illus 236). The boxes are suspended on a double cord looped through the bottom lugs and brought through the holes on either side of the cap before rising to the bandolier, where both ends are made fast. At this point in the sequence the musketeer is gripping the box while thumbing off the cap and pushing it out of the way up the cords. The slanting holes lock the cord so the cap will not slide back, allowing the spout to be inserted into the musket-barrel and the full charge tipped in. Below the musketeer's elbow is a pouch for bullets (and perhaps wadding), while the small triangular flask hanging below the bandolier is for priming powder. Looped at his back is a hank of spare match.

99 DP00/170, **107.079**, powder-box missing its base and bottom part and lacking a cap. Its proportions and surviving dimensions are similar to those of box 98 (Illus 235–6).

100 DP01/015, **170.093**, powder-box with cap, which at the time of writing had not yet been removed by the conservators. It has a bottom diameter of 25mm and a height from base to shoulder of 87mm, similar in form and dimensions to box 98. The cap is similar to that of box 98 though more truncated (Illus 235–6). The end of the suspension cord survives in each of the box's lower lugs, with locking knots underneath to resist a downwards pull. This suggests that the box was hung either from two separate cords, with each upper end tied to the bandolier, or on a single running cord fixed at each lower end and looped through the bandolier. A different arrangement is shown in the de Gheyn engraving.

101 DP00/149, **106.083**, powder-box, lacking its cap, 97.5mm high from base to spout rim, and 89mm from base to shoulder, significantly smaller than box 98. Its lower diameter is 27mm and the spout is 13.5mm wide (Illus 236). The shape is more rounded than box 98 and the lower part shows a distinct inwards curve. Its sides are 3–4mm thick, encasing a volume of *c* 20cm^3, indicating a powder-weight of some 30g (1.06oz). It is thus presumably intended for use with smaller shot than that associated with box 98 and the other main group from the bullet sample – 14-bore, with a median diameter of *c* 18mm and a weight of *c* 38g (1¼oz) – is the most likely candidate.

102 DP00/205, **109.081**, powder-box cap (not illustrated).

It is noteworthy that the Duart Point powder-boxes all have bases formed by a separate wooden plug, contrary to specifications in contract books for the New Model Army, which state that the boxes should 'be of wood with whole bottoms, to be turned within and not bored, the heads [caps] to be of wood' (Roberts 1989: 58). The Duart boxes are indeed 'turned within' and not bored, as their tapering profiles demonstrate, but the technically difficult process of hollowing out so deep a recess flaring downwards from a narrow top to leave an integral base at the foot evidently defeated the contract woodturners, who have adopted the simpler, but just as effective, solution of working upwards from the wider base and stopping the hole with a plug. It is still a remarkably adept piece of precision woodturning.

No trace of leather was noted on any of the Duart Point powder boxes. They may however have been oiled or painted to render them waterproof. State Papers of April 1649 record

£100 paid for '1000 collars of bandoleers, blue-painted in oil', and £75 for another 1000 painted black (Asquith 1981: 36). Another source specifies oiled bandoliers 'coloured blue with blue and white strings with strong thread twist with good belts, at twenty pence a piece' (Roberts 1989: 58).

Discussion

Examples of similar powder-boxes have been found on contemporary shipwrecks and, less commonly, from terrestrial contexts. The closest parallels are from Newcastle-upon-Tyne, from the excavation of a Civil War bastion (Ellison & Harbottle 1983). Among the finds were three powder-boxes of beech (*Fagus* sp) all of which showed evidence of having been covered with leather (Goodhand 1983: 206 and fig 17). The objects appear somewhat damaged and shrunk, perhaps from drying, and so their dimensions, especially lateral ones, may be distorted. Nonetheless no 123, which measures 110mm overall (without cap), 92mm to the shoulder, and has an 18mm-diameter spout and a bottom width of 24mm, is very similar to box 98 from Duart, while Newcastle nos 122 and 124 broadly match Duart boxes 99 and 100.

This seems to confirm the hypothesis that the two types of boxes match the two sizes of musket generally agreed to have been in service during the Civil War period, 12- and 14-bore, but the samples from both sites are very small and the suggestion must remain tentative. Box-caps were sometimes made of lead or pewter, numbers of which have been discovered on the battlefields of Edgehill and Naseby (Foard 2012: 170). Lead caps are known from Tantallon Castle in East Lothian, which saw action during the First Bishops' War in 1639 and again during Cromwell's invasion of Scotland in 1651 (Caldwell 1991: 342 illus 5), while two lead examples were recovered from an early 18th-century context during excavations at Landguard Fort, Harwich (Meredith et al 2008: 258–9).

Another closely contemporary find comes from the wreck of the Dutch East Indiaman *Vergulde Draeck*, lost on the coast of Western Australia in 1656 (Green 1977: 234–5). Seven wooden powder-boxes were recovered, five of which showed evidence of leather coverings. The best-preserved example (GT 1036) is complete with its wooden cap and measures 112mm from base to spout, 136mm overall, 36mm wide at the base, spout diameter 17mm. These dimensions are similar to those of Duart Point box 98 and Newcastle no 123. Wooden powder-boxes with a more bulbous profile have been recovered from the wreck of *La Belle* (1686). At 100mm × 36mm they have a similar capacity to the larger Duart Point boxes (Bruseth 2014: 76).

It is proposed to categorise the larger boxes (12-bore?) as Type I and the smaller ones (14-bore?) as Type II, tentatively linking them to the pattern identified in the Duart Point shot sample. This seems to reflect the statement of Lord Orrey, Cromwell's commander in Ireland, that muskets should be 'at one bore, or at most two sorts of certain bore, the bigger for the stronger, the smaller for lesser bodies … for want of this I have seen much hazard undergone' (Asquith 1981: 32). The old heavy 12-bore musket had a barrel 48in (1.22m) long while the lighter 14-bore replacement, used without a rest, was 6in (0.15m) shorter (Roberts 1989: 19–20). Both the bullets and the powder-boxes from the Duart Point wreck indicate that the two types were still in service as late as 1653.

Metal powder-boxes are also known. Twenty-four have been recovered from a late Elizabethan wreck off Alderney (Bound 1998: 75). They were made of copper-alloy sheet with seams closed with lead-tin solder. Heights (with caps) ranged from 99mm to 106mm and maximum body diameters from 27mm to 31mm, indicating capacities broadly similar to the Type I wooden examples described above.

Bandolier

103 DP01/045, **105.074**, piece of leather strap 125mm × 40mm with rolled and stitched edges and three pairs of 4mm holes, set obliquely across the strap (Illus 236). This can confidently be identified as part of the distinctive type of bandolier used by musketeers to hang their powder-boxes from cord lanyards as described above. The oblique set of the holes would have given the boxes a vertical hang when the bandolier was slung across the chest, and the 45mm spacing between pairs would allow for 12 boxes, the usual number carried (Asquith 1981: 14) (Illus 236–7).

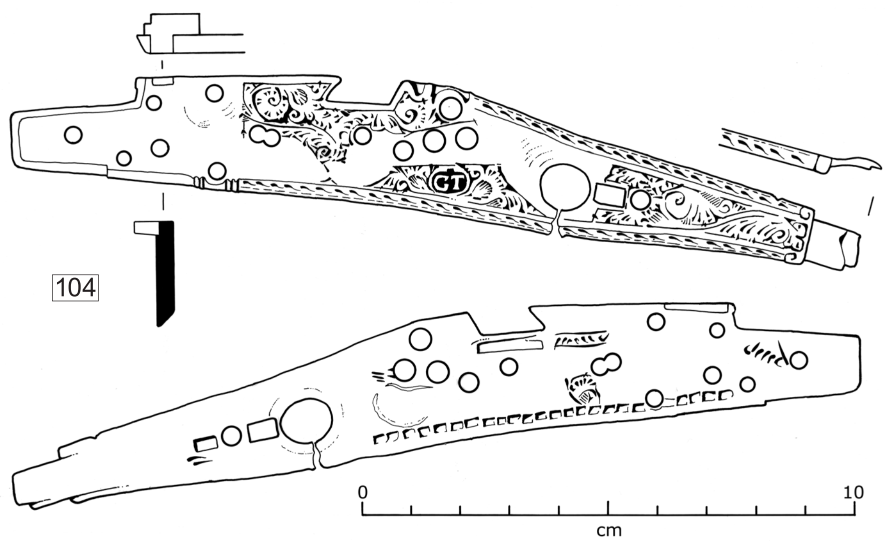

Illustration 238
Pistol lock-plate 104 (DP174831)

Illustration 239
Detail showing the maker's initials 'GT' on the pistol lock-plate 104.
Scale in millimetres (DP 174346)

Gun furniture

104 DP92/DG11, findspot not known, brass lock-plate 175mm long with holes and recesses appropriate to a snaphaunce lock (Illus 238). That it is fashioned for a left-handed mechanism suggests it is from the left member of a handed pair of pistols. The lack of a screw-hole in the tongue at the butt end suggests that it was intended to be gripped here by a pommel, further indication that it belongs to a pistol and not a musket. The piece is chased with foliar decoration and carries the letters G T in a circle flanked by thistles (Illus 239).

These initials can be identified as those of George Turner, a dagmaker (gunsmith) in Edinburgh's Canongate whose apprentice-piece ('sey') was accepted on 21 May 1639, being described as 'a pistolet with an iron ratchet sufficiently made and stocked in timber'. He was admitted freeman on 28 June 1639, and on 10 June 1650 was appointed King's Armourer 'anent the making and mending of his highness's hagbuts, pistolets, acre [arrow] and pellet bows and all iron weapons'. Turner's royal appointment suggests that he was by then a craftsman of the highest reputation. He was alive on 4 January 1660 when he acted as a seymaster (member of an apprentice assessment board) for Hugh Somervell, but by 28 August 1662, when his son William (also a gunsmith) was admitted burgess, he is described as 'deceased' (Whitelaw 1977: 209).

The weapon is of distinctively Scottish type, and the tongue at the rear of the lock-plate would suit the reception of a lemon-shaped butt terminal (Boothroyd 1981: 327–8). A pair of lemon-butted pistols with the unidentified initials AG and the date 1634, now in the Marischal College Museum, Aberdeen, have lock-plates of similar form (Kelvin 1996: 112 fig 27) (Illus 240).

Gunflints

105 DP00/142, **106.075**, deep wedge-shaped gunflint with front edge damaged (Illus 241).

DP01/092, **215.085**, shallow gunflint with curved front edge, and rear part broken off (Illus 241).

Edged weapons

107 DP92/178, findspot unknown, a concretion 380mm long was X-rayed to reveal the ornate wire-wound hilt,

Illustration 240
Top: the left-handed example from a pair of Scottish lemon-butted snaphaunce pistols, marked 'A G 1634', probably made in Edinburgh (© University of Aberdeen. Licensor www.scran.ac.uk). Below: at a slightly larger scale, the lock-plate 104 from the Duart Point wreck

spherical pommel, guard and quillons of an English or Dutch rapier of the first half of the 17th century (Dufty 1974: 19–20 and pl 28) (Illus 242). The 25mm-wide blade, of which the top part survives as a void in the concretion, is encased in the remains of a leather scabbard. The well-preserved hilt was subsequently extracted from concretion by Dr Theo Skinner of National Museums Scotland to reveal that it is covered in sharkskin and wound with gold and silver wire (Illus 243–5). The top and bottom ends of the hilt are encircled with woven gold-wire collars. Negative impressions within the concretion preserve details of vanished ferrous and organic materials including the gilded cherubic faces in relief which had adorned the guard and quillons, and surface gilding around the sharkskin hilt. What appears to have been a steel square-sectioned pin penetrates the blade close to its top, and is perhaps associated with a

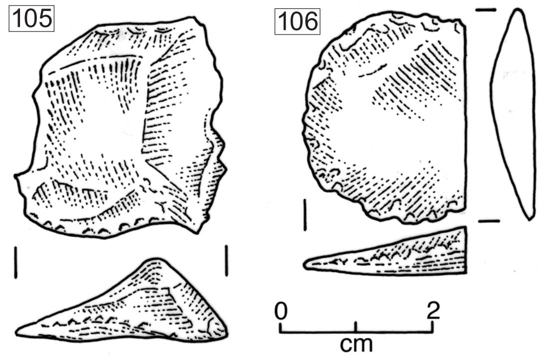

Illustration 241
Gunflints 105–6

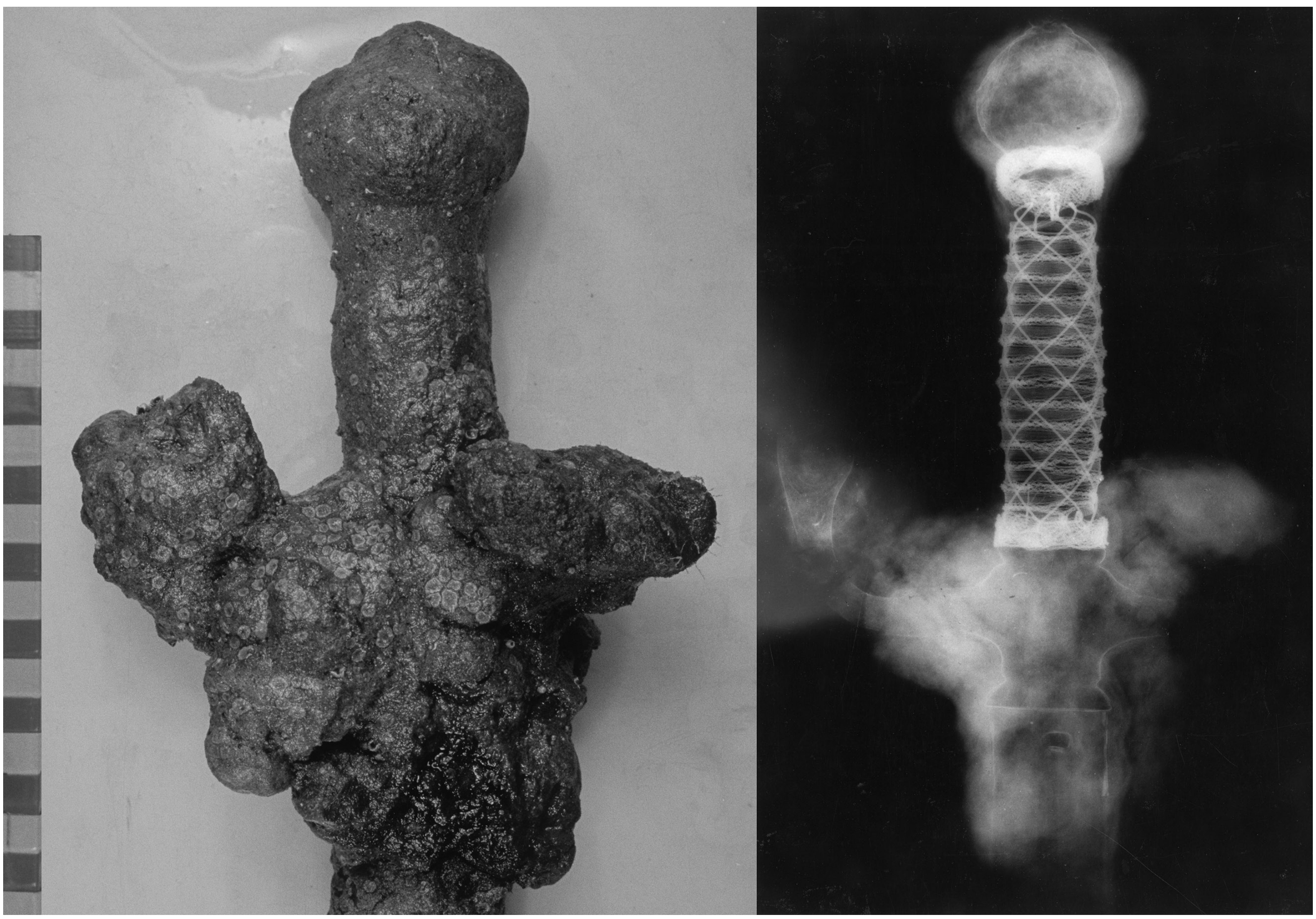

Illustration 242
Concreted sword-hilt 107 (DP 174339), and radiograph (SC 1127030) (Image © National Museums Scotland)

Illustration 243
Sword-hilt 107 wound with gold and silver wire, after removal from concretion and conservation. Scale in millimetres (DP 174340)

Illustration 244
Fragment of the sword-hilt 107, showing sharkskin overlaid with gold-leaf. Scale in millimetres (DP 174343)

Illustration 245
Negative image from the concretion surrounding the sword-hilt 107, showing a human face in relief (DP 173232)

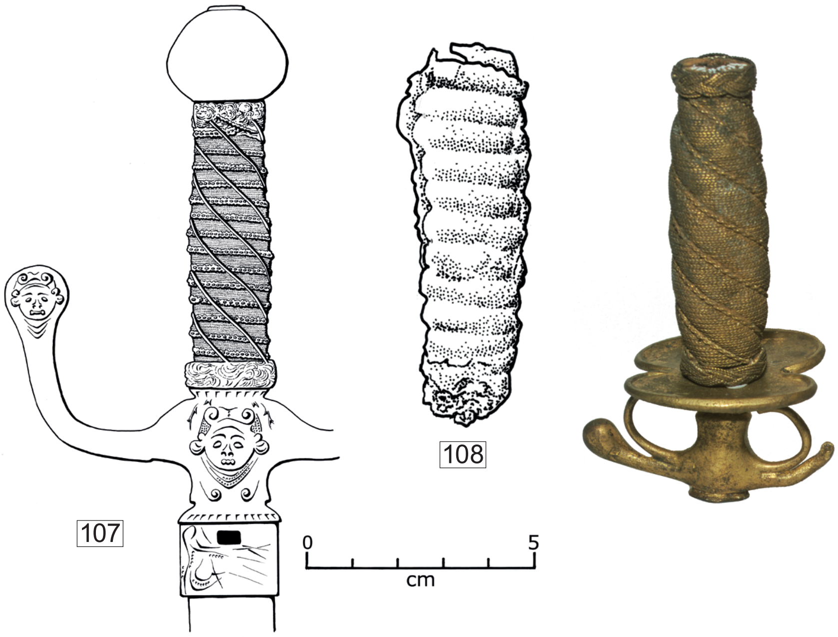

Illustration 246
Left: sword-hilt 107 reconstructed. Centre: concretion of another probable hilt 108. Right: hilt from the wreck of *De Liefde* (1711)

missing hand-guard, no doubt of richly decorated silver to complement the opulence of the overall design.

This is an exceptionally high-status weapon which may well have belonged to the ship's captain, Edward Tarleton. Close parallels are hard to find, but rather later and more commonplace sword-hilt furniture with some similarities has been recovered from the wreck of the Dutch East Indiaman *de Liefde*, wrecked on the Out Skerries of Shetland in 1711 (Illus 246) (Bax & Martin, 1974: 87)

108 DP99/058, surface findspot unknown, a concretion 85mm long with some apparent similarities to 107. Not radiographed or examined internally at the time of writing (Illus 246).

109 DP99/068, **079.094/087.100**, concretion of what appears to be a complete sword 1.07m long. Not radiographed or examined internally at the time of writing (Illus 247).

Note: At the time of the wreck's discovery in 1979 concreted remains identified as a musket, a pistol, and a sword-hilt were observed, probably in the vicinity of Guns 2 and 3. Their present location is unknown (John Dadd pers comm).

8.3 Lead bullets

Glenn Foard

Large assemblages of lead bullets from 17th-century wrecks are a hitherto poorly explored archaeological resource, the

Illustration 247
A complete sword 109, still in concretion (DP 174165)

analysis of which can contribute to the interpretation of contemporary battle archaeology. Because bullets from wrecks are normally unfired they suffer none of the distortion or weight-loss which result from firing and impact-damage seen in battlefield assemblages. As a result the groupings revealed in the calibre graphs are more discrete and, when windage is taken into account, are likely closely to represent the weapons in use in the relevant nation or army. In addition, the absence of attributes resulting from use means they provide a valuable baseline data-set for manufacturing attributes against which to compare battlefield bullets. Analysis is further enhanced where, as on the *Vasa* and *La Belle* wrecks, intact barrels full of bullets are recovered, as these provide confirmation that the contents of each represent a single intended calibre. The tightness of calibre groupings, as seen in the graph (Illus 248), may even offer an opportunity to study the evolving efficiency of munitions manufacture from the late Medieval period through to the early 19th century, when the full impact of the Industrial Revolution on manufacturing consistency had been felt. Assemblages from magazines do exist on land, as for example the late 17th-century material from the Jacobite garrison at Ballymore in Ireland (Foard 2012: 58–61), but they are rare, while fragmentary collections might also be found on sites of the destruction of artillery-trains during battles. However these groups will normally lack the completeness, clarity and close dating of the closed assemblage from a wreck.

A total of 102 spherical lead bullets recovered from the Duart Point wreck was provided for analysis (Illus 248). No slugs or other non-spherical forms were present. All appear to be of ‘pure’ lead, with no evidence of exceptional corrosion which might suggest a mix of tin or other metal. This is a small assemblage compared to those from some other 17th-century wrecks, such as *Vasa* with more than 8000 bullets, *Batavia* for which 1794 were reported on, and *La Belle* which produced more than 300,000 (Green 1989: 70–1; Bruseth & Turner 2005: 95–6; Cederlund 2006: 368). The paucity of numbers may simply be because the excavation at Duart Point was only partial, but it is also possible that this assemblage does not represent a large and intact munitions delivery stored in barrels, since historical sources imply that at the time of the wrecking most of the troops and military stores had come ashore. Such distinctions are relevant to the interpretation of bullet assemblages from wreck-sites, as there may be significant differences between the munitions already issued for the use of troops on the vessels themselves, as opposed to consignments carried to supply field-armies or for other specialised use. On *Vasa* most of the bullets were intended to be fired as case-shot (that is, enclosed within a wooden case). This is one type of ‘hail-shot’ or composite anti-personnel munition used in the mid 17th century in which large numbers of bullets or other projectiles were fired from an artillery-piece. Although fragments of one wooden case were found on the Duart Point wreck, there is no evidence to suggest that the bullets recovered were intended for use in case-shot as opposed to small-arms.

During excavation the bullets were documented in groups rather than individually, although all came from the vicinity of the collapsed stern, which suggests that they had been contained within the cabin interior, so are unlikely to have been part of a general stores consignment. In the absence of exact locational information for each bullet it has not been possible to seek significant patterning in the assemblage, which might

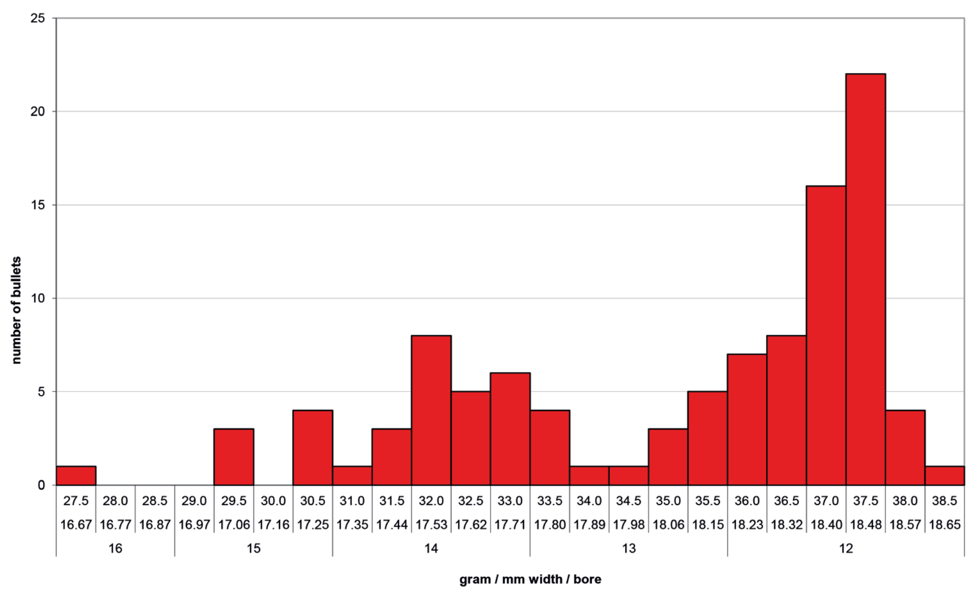

Illustration 248
Left: Sample group of lead bullets (DP 174347). Right: the gramme/bore graph of the bullets from the wreck (Glen Foard)

indicate that different calibres came from different locations. The bullets were examined as part of a programme of research into unfired-bullet collections, to provide a reference-point for the study of 17th-century battlefield assemblages, and were analysed according to procedures defined for the wider study (Foard 2012). Each bullet was weighed, which for spherical lead bullets is not only the quickest but also the most consistent method of classification, as long as the bullets do not have a significant admixture of other metals such as tin, and yielding the clearest identification of discrete calibre groupings, especially true for battlefield survey where distortion through firing and impact can make measurement of diameter impractical for a large percentage of the assemblage.

A sample of 36 bullets was then also measured for width and depth, in order to correlate mass in relation to diameter, and their attributes fully described. The width of a bullet is defined as the diameter close to the mould seam, where the two halves of the bullet mould came together, and it is this that provides the most accurate linear measurement of the intended calibre. The depth of the bullet is taken at 90° to this and can vary substantially from the intended calibre if, for example, the mould faces have been reworked or if lead or other debris has collected on these faces during casting, which is a common occurrence. The comparison of width with the diameter calculated from weight shows that with the Duart Point wreck assemblage the latter almost always underestimates diameter by an average 0.4mm. The variation was between −0.2mm and +0.8mm, though the latter had significant concretion while a further six of the sample could not be measured due to extreme concretion. This suggests that in exceptional cases, like the Duart Point wreck, where accurate width measurements can be taken, because most bullets are not altered by significant corrosion or distorted by firing and impact, this is a more accurate indication of calibre. However, experimental data are required to test such conclusions, as the 0.4mm average represents only 0.2mm

Illustration 249
Characteristic features of lead bullets: (a) concretion masking surface features; (b) extreme example of a flash along the mould seam, which has subsequently been smoothed, presumably by contact with other bullets during transport; (c) snipped sprue and mould-line; (d) distinct parallel lines, reflecting grooves in the mould; (e) bullet showing impact damage, presumably from being fired; (f–h) possible burr-shot, with numerous small gouge-marks (DP 174044–174051)

on either side of the bullet and it is possible that corrosion or concretion effects frequently result in this degree of increase in bullet diameter while having minimal effect on weight.

Because lead is typically very stable in seawater, as it is in many conditions on land, the majority of the bullets show minimal corrosion, and most surface attributes are therefore clearly visible. A small percentage of the assemblage shows a high degree of concretion, presumed to be calcium carbonate blackened with lead sulphide, which normally obscures detail rather than represents destruction of the original lead surface (Illus 249a) (Cronyn 1990: 202–5). This concretion rendered full analysis of these bullets impossible and also precluded accurate linear measurement, making weight the only indicator of calibre. It is unclear whether the weight was significantly distorted by such concretion, though the data suggest a slight reduction rather than an increase.

The gramme/bore graph (Illus 248) indicates two distinct calibres present in the Duart Point assemblage, both intended for use in muskets: one of 14-bore, centred on 17.6mm diameter, and the other of 12-bore, centred on 18.5mm. At this period the bore was the standard term for the classification of bullets and of the guns for which they were intended. It represented the number of bullets per pound of lead, the musket barrel itself being *c* 1.5mm greater in internal diameter than the bullet, representing the windage which allowed the bullet to be introduced into the gun-barrel. There are just eight bullets (*c* 8%) of other calibres in the sample. Fourteen- and 12-bore were the two standard calibres still in use for muskets in the 1660s, after the Restoration.

The bullets from Duart Point tend to suggest that by 1653 this standard may already have been enforced in the New Model Army, which was the national army formed by Parliament in April 1645 and disbanded at the Restoration in 1660 (Kishlansky 1979). More and larger assemblages from the period, however, need to be examined to confirm such standardisation and, if so, the relative importance of the two calibres. In contrast, a sample of unfired bullets from the battle of Edgehill (Foard nd: fig 3) suggests that in 1642 various smaller bores were also still in use. The slight bias of *c* 0.5g in the Duart Point bullets towards the lower end of the 12-bore range, visible in the graphs, cannot be explained at present. The dominance of 12-bore is clear in both assemblages, and also in the surviving Civil War muskets in the Littlecote collection in the Royal Armouries, though this is not repeated on all sites (Foard 2012: 71–4).

The Duart Point bullets show typical surface features indicative of manufacturing techniques. These include the snipped sprue, where the lead that filled the pour-hole into the mould has been removed with nippers, leaving distinctive half-moon surfaces with a central bar (Illus 249c). This example also shows the faint mould-line where a tiny amount of lead has seeped into the join between the mould halves to create a slight ridge around the bullet. Occasionally a large offset between the halves, resulting from poor registration of the closed mould, gives a misshapen bullet. On another Duart wreck bullet the faces of the mould did not seat properly and a substantial amount of lead seeped out to create a flash several millimetres wide (Illus 249b). In this example both are seen, with the flash subsequently swaged over, probably by bumping against other bullets during storage and transport. Seven bullets clearly show what appear to be grooves and ridges encircling the shot in regular lines centred on the axis of the sprue (Illus 249d). These latitudinal lines reflect tooling on the inner surface of the mould-chamber, which was presumably machined with a router or similar instrument (Foard 2012: 95). The regular pattern of lines is far more fine and consistent than the coarser ridges which can be caused when a bullet is cast in a cold mould and the lead solidifies in stages as the mould is filled.

Bullets often have these manufacturing attributes obscured as a result of prolonged bumping against other bullets. It has been suggested that this was the result of transport in barrels (Sivlich 1996). The presence among the Duart Point assemblage of 14 bullets where such fine surface detail survives may indicate that this is not the case. As yet the effects of bumping have only been demonstrated experimentally through prolonged carriage in a re-enactment musketeer's bullet-pouch. Alternatively it may be that carriage by sea is far more gentle than carriage on land by cart, and therefore bumping does not occur to the same degree.

A few of the Duart Point bullets carry evidence of intentional modification, through various types of gouging to create a rough surface (Illus 249f–h). Microscope imaging shows clear evidence of tool-marks in the form of striations along the length of each gouge (Illus 250). These bullets

Illustration 250
Microscope image showing striations along the length of each gouge.
Scale 1 millimetre (Image © National Museums Scotland)

comprise 6.7% of the assemblage. Similar evidence is also present on assemblages from contemporary battlefields, representing for example 2.5% of the Edgehill musket-calibre bullets. Such bullets have tentatively been described as 'burred', but there is conflicting evidence as to what is meant by this term in contemporary sources.

There are references in military manuals and supply records to both burr shot and 'rough-hewn' musket balls. However a source of *c* 1600 describes burr shot as 'fragments of iron rough and ragged', and in 1595 it is specified as 'burres alias haileshot'. There is thus some confusion over the exact meaning of the term, which may even change over time, for a burr could also be a sprue (OED, quoting a 1611 military source). It is normally assumed that the burring was carried out by individual musketeers after bullet issue rather than being an attribute created during normal manufacture, and therefore indicating that these bullets, at least, had already been issued for use. The sharp edges of the Duart Point burring, compared to the rounding of the edges seen when an experimentally burred bullet has been experimentally fired, indicate that although the burred bullets in this assemblage had been modified for use, they were never fired (Foard 2012: 103).

All the burred examples from Duart Point are of 12-bore, a musket calibre. If this was intended to be fired as 'hail-shot' it would have been packed into wooden cases, canvas bags, canisters of tinned iron or loose in the barrel of an artillery piece for firing in an anti-personnel role, as, for example, the 'case of wood for burr shot' noted in an ordnance inventory of 1635 (TNA WO55/1690, cited in Blackmore 1976: 294). However, the experimental firing of hail-shot in both cases and canvas bags has shown that the whole surface of the vast majority of bullets is completely re-formed during firing, and thus burring would not survive the internal ballistic forces of an artillery piece. As this will presumably have been known to contemporaries it is difficult to understand why the time-consuming modification by gouging would have been undertaken (Allsop & Foard 2008). The alternative is that they were for use in muskets. Experimental firing has shown that roughened bullets can be fired from a musket, and that the surface suffers only slight smoothing. At least two burred bullets showing evidence of firing from a musket were recovered in the Edgehill survey, while the distribution-pattern on that battlefield shows no association between these bullets and hail-shot groups from the site (Foard 2012: ch 5). Thus there is at present no secure explanation for this type of bullet, and even the contemporary name remains uncertain.

Unexpectedly, one bullet from the wreck collection shows very clear impact damage, suggesting that it had been fired (Illus 249e), but as no reference collection of experimental bullets showing types of impact damage has yet been established it has not been possible to confirm this or to suggest the type of impact or the material impacted. However, one might expect that ships which had been engaged at close quarters would have bullets embedded in their timbers. If so, then the accurate plotting of the distribution of impacted and unimpacted bullets, where present in significant numbers on well-preserved wreck-sites, might yield significant patterning.

8.4 Chest, chest-fittings and box-lid

110 DP99/069, **093.087/098.094**, immediately above the run of panelling 21 the remains of a wooden chest (see Chapter 4.2 for the significance of its stratigraphy). The substantially intact single baseboard measures 1.044m × 0.36m and is 20mm thick (3ft 5in × 1ft 4in × ¾in) (Illus 251–2). The south-east side and south-west end are largely intact, but the tops of both elements are eroded so their full height cannot be determined, though it was not less than 0.27m (10½in) including the baseboard. A small fragment of the north-east end survives close to its joint with the south-east side but the rest has gone, along with the whole north-west side. Side and end boards are 20mm (¾in) thick. The corners were secured with lap-joints 9mm deep, and the carcass was held together with iron nails, the positions of which are indicated by holes in the surviving timbers, their locations shown diagrammatically in Illus 252. It may be noted that the spacing and symmetry of the three nails securing the surviving corner joint suggests that the highest point of the chest's surviving edge is close to its original top. A rectangular slot 12mm wide × 9mm deep (½ × ⅜in) has been cut vertically from top to bottom on the interior of the side plank, presumably to house a divider for an end compartment 0.30m (1ft) deep. The minimum capacity of the chest is 0.077 m^3 or 2.68 ft^3.

111 DP99/106, **098.092**, a cleat with a squared central slot 20mm wide and 12mm deep, positioned vertically and secured to the south-west end of the chest 110 with four short nails set in pairs 0.18m (7in) above the base (Illus 253). Holes for the vanished nails penetrate the end of the box where their points were presumably bent over to fix them. The cleat no doubt housed a pin for securing a rope becket, the traditional form of end-handle on a sea-chest.

This chest invites comparison with the large collection recovered from *Mary Rose* (Richards with Every 2005). It fulfils some of the criteria for their Types 1 and 2, both of which are categorised by the 'base resting directly on the deck' (ie with flush bottom) but sub-divided by the absence of hinges and a lock (Type 1) or their presence (Type 2). This cannot be determined with certainty for the Duart Point chest, although the end compartment, presumably intended for small valuables, would seem superfluous if the main lid could not be closed and locked. The chest does however fit into the category of sub-type 2, which is 'nailed, boards affixed through "fitting"

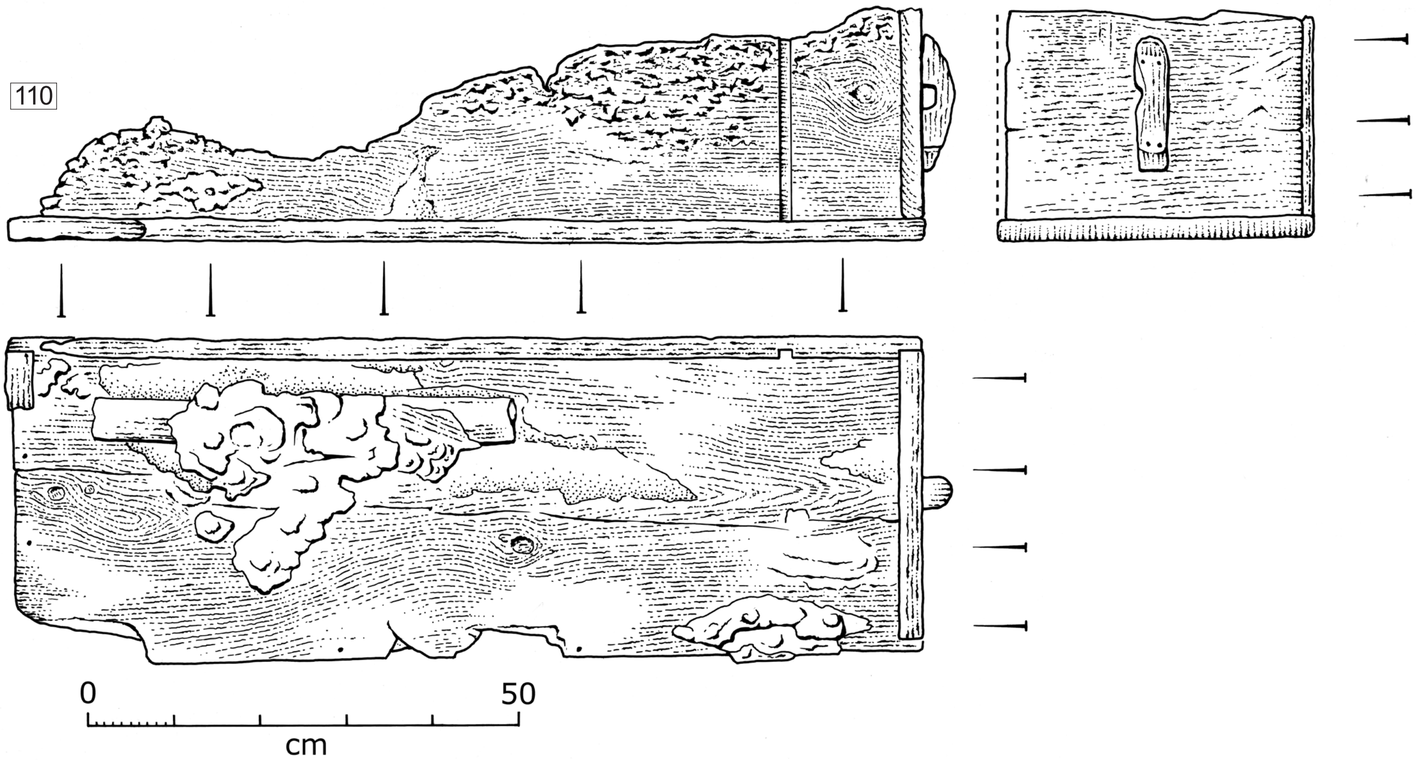

Illustration 251
Surviving elements of a wooden chest 110 (DP 174841)

rebates up to 5mm deep cut along the edges of some carcass elements' (Richards with Every 2005: 387). Though largely devoid of artefacts when excavated (it contained only three pieces of iron roundshot and four musket bullets, and some indeterminate scraps of wood) it seems likely that this was an ordinary seaman's chest, to keep his personal possessions tidy and secure.

112 DP99/108, **101.090**, fragmentary cleat 118mm × 54mm × 25mm with most of the central slot surviving. Estimated original length 216mm; slot *c* 25mm wide by 15mm deep. Square 6mm nail hole on the surviving side (Illus 253).

113 DP03/020, **109.097**, cleat missing part of one end, present dimensions 240mm × 33mm × 38mm; original length *c*.300mm. Slot 45mm wide by 20mm deep. Three square 6mm nail-holes along the central axis. A fourth at the missing end is presumed (Illus 253).

114 DP03/022, **109.090**, complete cleat with one end shorter than the other, 305mm × 55mm × 60mm, slot 47mm wide by 32mm deep. Four square 6mm nail-holes along the central axis, two on either side of the slot (Illus 253).

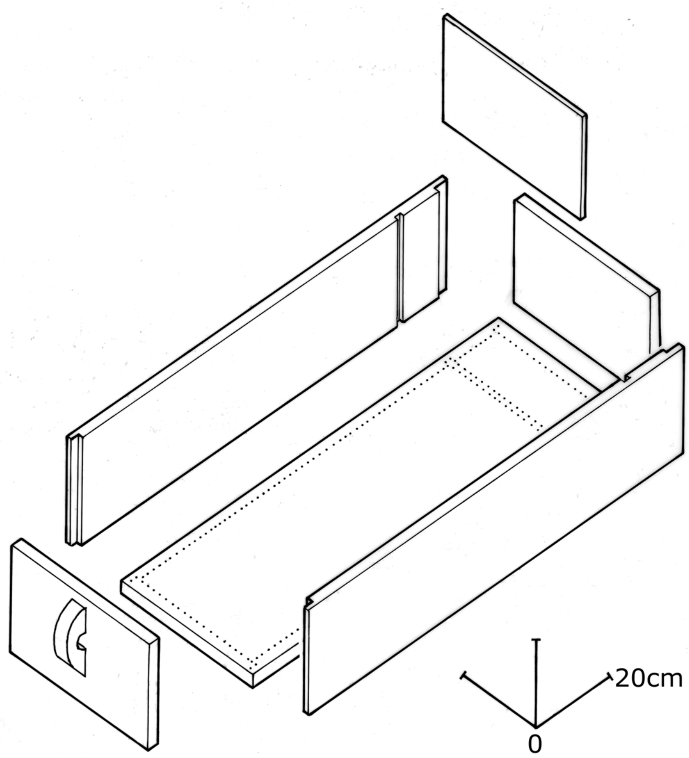

Illustration 252
Isometric reconstruction of the wooden chest 110 (DP 174842)

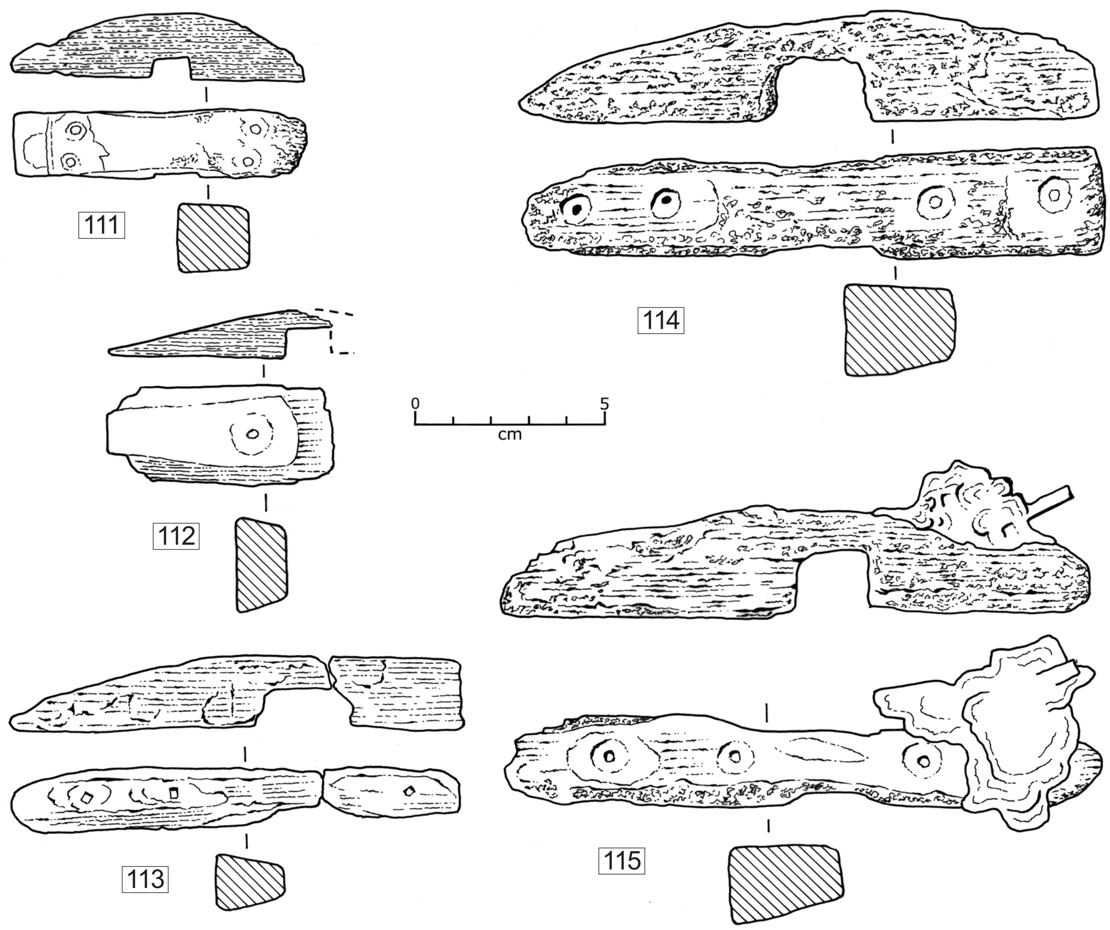

Illustration 253
Wooden chest cleats 111–15; 111 is from chest 110 (DP 174843)

115 DP03/025, **110.085**, cleat similar to 114, also with one shortened end, 310mm × 49mm × 55mm, slot 38mm wide by 30mm deep. Two holes for 6mm-square nail shanks on each side, along the horizontal axis (Illus 253).

There is no doubt that the cleat on the surviving short end of the chest 110 was set vertically, for it was found in that configuration, still held by the corroded remains of four nails. All the wooden cleats identified on the *Mary Rose* chests were set in the same way (Richards with Every 2005: 388), and traditional sea-chests are still made with rope becket-handles slung on vertical cleats (frayedknotarts.com/beckets). A short pin of wood or metal would have passed through the hole in the cleat, and the eyes of a short rope becket seized to both ends. The *Mary Rose* produced a large number of chests and chest components, from which a minimum of 49 individual examples can be identified (Richards with Every 2005: 387). They clearly served a number of functions including the stowage of personal kit, for which the smaller and sometimes more elaborately constructed chests were employed, as an analysis of their contents shows. The Duart Point chest appears to fit this category, very much at the lower end of the status scale.

116 DP99/039, **066.105**, handle made of 40mm-circumference three-strand hemp rope, right-hand Z-twist lay, with a crown-and-wall knot at each end which locks the strands into the lay (*Admiralty Manual of Seamanship* vol 1 1972: 177–8; see note on cordage measurement in Chapter 6) (Illus 254). This knot is commonly used to finish off the ends of seizings to prevent them from unreeving. Handles such as this are known from *Mary Rose* (Richards with Every 2005: 388–9), where they pass through two holes drilled horizontally in the box-end and are secured with knots. It can be surmised that after the first knot was tied the free end was passed from the inside through the

116

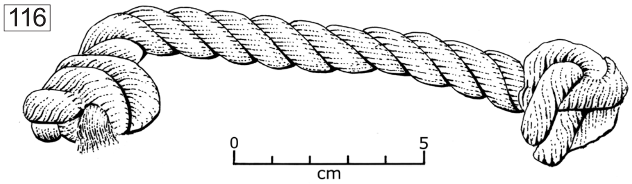

Illustration 254
Rope handle 116 from a chest or box (DP 174844)

first hole and then returned through the second, where the three strands were worked into an anchoring knot.

Bigger chests were used for the tidy organisation of specialist gear, such as carpenter's tools or apothecary's equipment, and their presence on the Duart Point ship can be inferred from the larger cleats in the assemblage. They were also used for the storage of weapons and munitions, and several chests full of longbows and arrows were found on *Mary Rose*. These had horizontally set rope handles on their ends, and it may be that this was a characteristic of munitions boxes. Becket handles would have served well enough aboard ship for slinging or handling over short distances, but for carrying (for example) a crate of muskets on shore the wider, more easily grasped, rope-loop handles would have been more suitable (Richards with Every 2005: 388).

117 DP92/172, findspot unknown, oblong pine board, 508mm × 272mm × 18m, cut through centre grain, with four nail-holes and the impressions of three straps or hinges extending to the centre of one side, and a single central strap-mark on the other (Illus 255). Probably a hinged box-lid with a locking latch.

8.5 The pocket-watch

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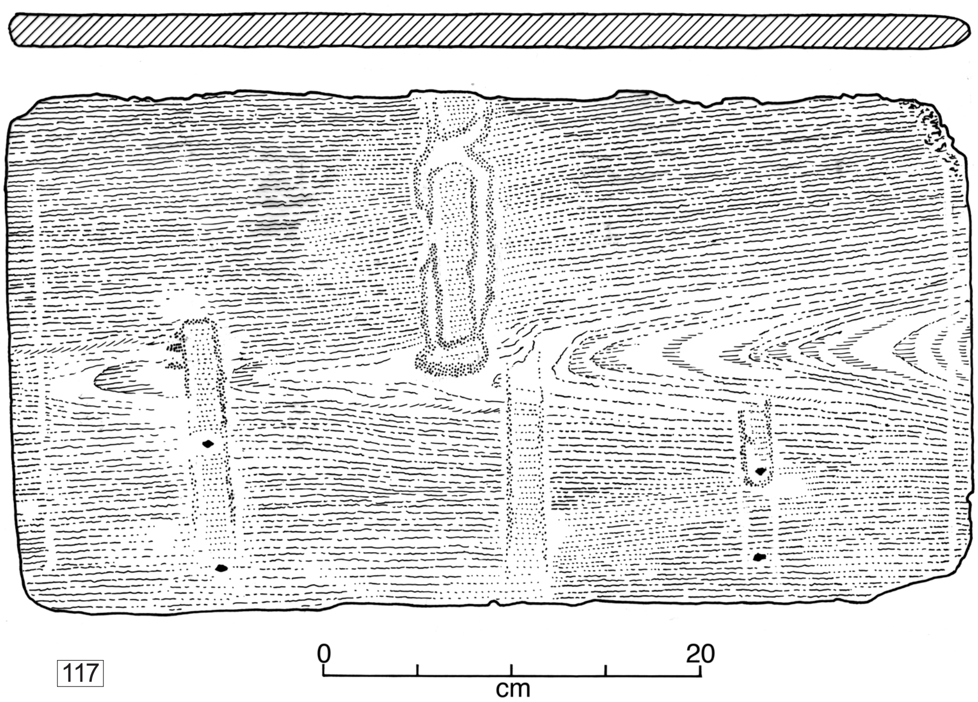
(this report is based on a publication by these authors in 2010 in the *International Journal of Nautical Archaeology*)

118 DP92/252, found loose on the sea-bed at **091.088**. It appeared to have been recently displaced by the erosion of adjacent deposits. Though covered by concretion, it was tentatively identified as a pocket-watch. X-ray radiography at National Museums Scotland in 1994 confirmed this identification and close scrutiny suggested that within the concretion much of the internal mechanism survived (Illus 256–8). Conventional radiography, however, is very limited in its ability to investigate so small and complex an artefact, and at this stage the conservation process was unable to reveal the



117

Illustration 255
Rectangular plank 117 with evidence of hinges, probably the lid of a chest or box

> mechanism more closely without intrusive procedures which would irreversibly change the object.

Early modern pocket-watches are rare archaeological finds, but several have recently come to light, especially from submerged contexts or in the inter-tidal zone. The best-known was recovered from the sunken remains of Port Royal, Jamaica, its stopped hands supposedly recording the exact time of the disastrous earthquake on 7 June 1692 (Link 1960: 173). Also of note is the 17th-century watch in a case made from a large emerald, part of the Cheapside hoard found close to the Thames (Forsyth 2013). Another 17th-century pocket-watch, made by 'Johannes Cooke Londini' was found in the Thames between Tower Bridge and London Bridge. This watch was in good condition with the inner case very well preserved, to the extent that the maker and place of manufacture could be read on the back-plate (Meehan et al 1996).

In 1983 an 18th-century pocket-watch was found on the wreck of HMS *Pandora*, lost on the Great Barrier Reef in 1791 (Carpenter et al 1985). This watch, conserved by the Department of Materials Conservation at the Western Australian Maritime Museum, was found encased in concretion, but the interior was in good enough condition for Hugh Whitwell, the antique-watch restorer engaged to reassemble it, to advise that it could be restored to working order. The watchmakers' names, 'J & J Jackson, London', the number '9866', and a 1788 hallmark were identified on the case. Individual parts of pocket-watches are sometimes found on shipwrecks as, for example, the cock from a verge fusee watch from the wreck of *Adelaar*, a Dutch East Indiaman wrecked off Barra, Outer Hebrides, in 1728 (Martin 2005: fig 30.11).

Microfocus 3D X-ray computed tomography

Following the recent development of a high-precision microfocus X-ray computed tomography system by X-Tec Systems Ltd and its application to the study of an ancient astronomical calendar recovered from a 1st century BC Greek shipwreck in the Mediterranean, the so-called 'Antikythera Mechanism' (Freeth et al 2006; Ramsey 2007), it was decided to apply this technique to the Duart Point watch. In the Antikythera investigation the Three-Dimensional Computed Tomography (3D-CT) had revealed very fine inscriptions on the mechanism which enabled its function to be understood. 3D-CT images are created from a set of high-resolution two-dimensional (2D) X-radiographs collected during a single rotation of the object with high accuracy in the positional alignment. The Computed Tomography (CT) dataset, and the associated image-management software, allow the researcher to visualise the object in three dimensions, to strip away components, and to slice it in any arbitrary direction to see interior detail.

The watch was mounted in a polythene box, held securely with Plastazote foam, and fixed on a stand for investigation. The main limitation of such analysis is generally the depth to which X-rays will penetrate. This depends on the X-ray energy and the material density – for brass at 225 kV the maximum depth will typically be *c* 40mm – while the

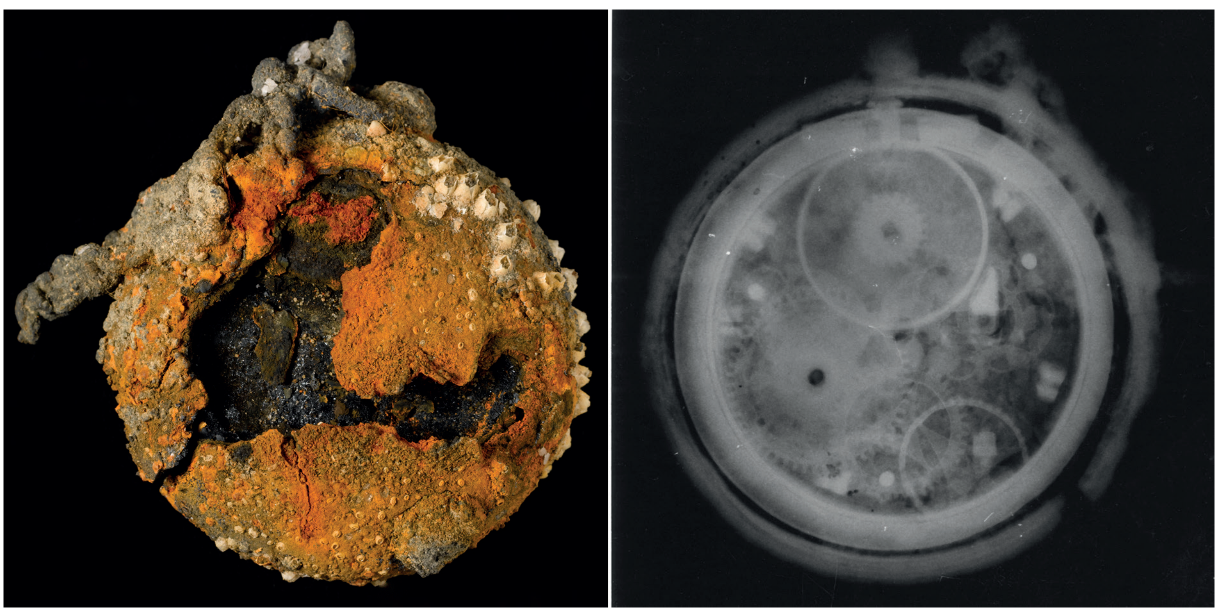


Illustration 256

Left: the watch 118 as found. Right: conventional radiograph of the watch (both images © National Museums Scotland)

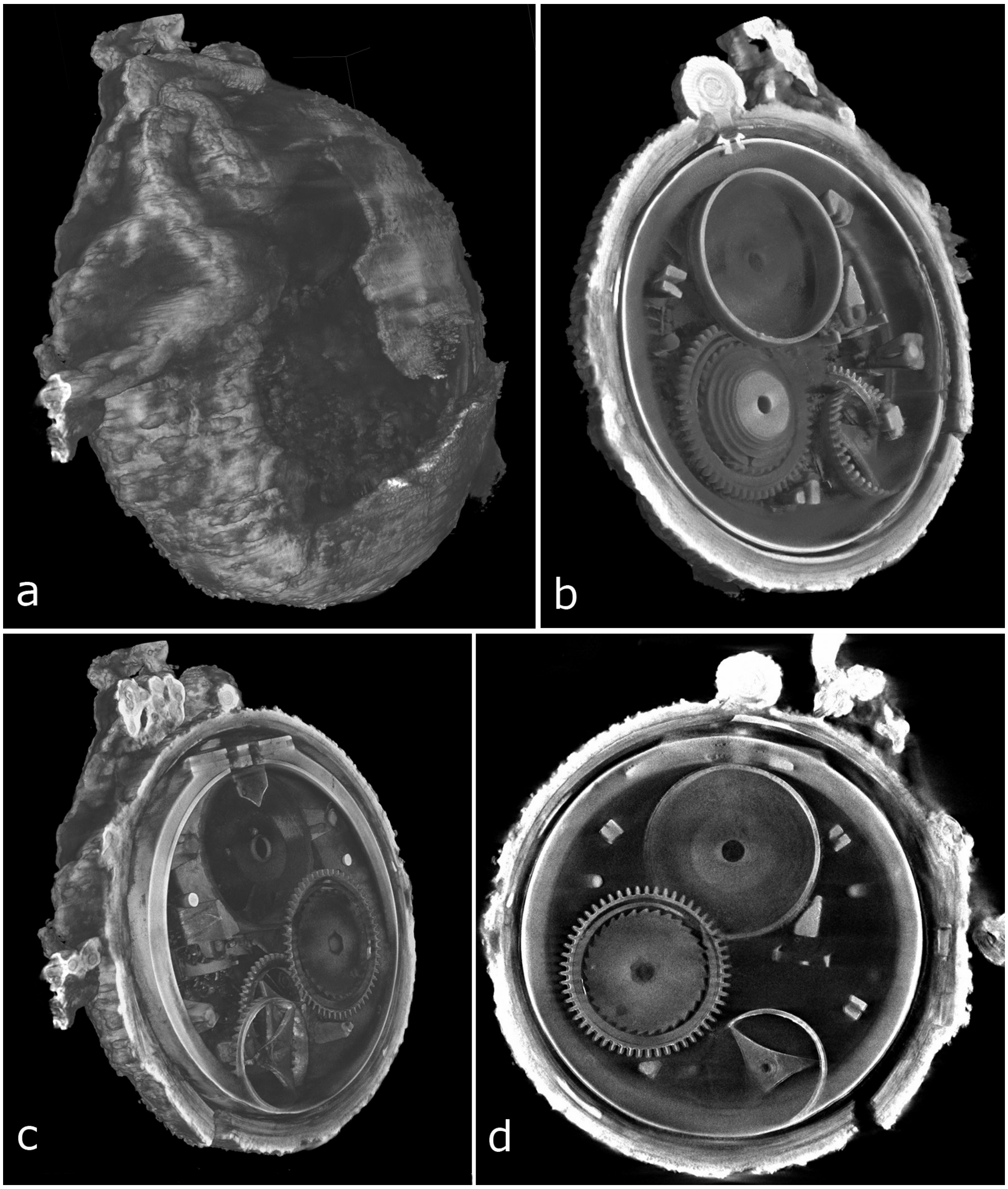


Illustration 257
3D-CT images, showing: (a) reconstruction of the volume of the watch; (b) 2D slice through the 3D-CT volume (or '2D-CT slice') after image processing, showing the inner mechanism, including traces of the watch-spring in the barrel and four Egyptian pillars; (c) the inner mechanism; (d) 2D-CT slice, after image processing, showing the fusee click teeth (all images © National Museums Scotland)

limited space in the CT system makes the technique suitable only for small, relatively light objects. These conditions limit the investigation of dense materials such as heavy metals. The mounting requires the object to be centred and completely stable during scanning to allow accurate registration of each X-ray image. The manipulator is accurate to about 2μm and rotates with a precision of less than 70 milli-radians.

The object was investigated using an X-Tek HMXST-CT system from Metris UK, using a 5μm spot-size 225kV tube

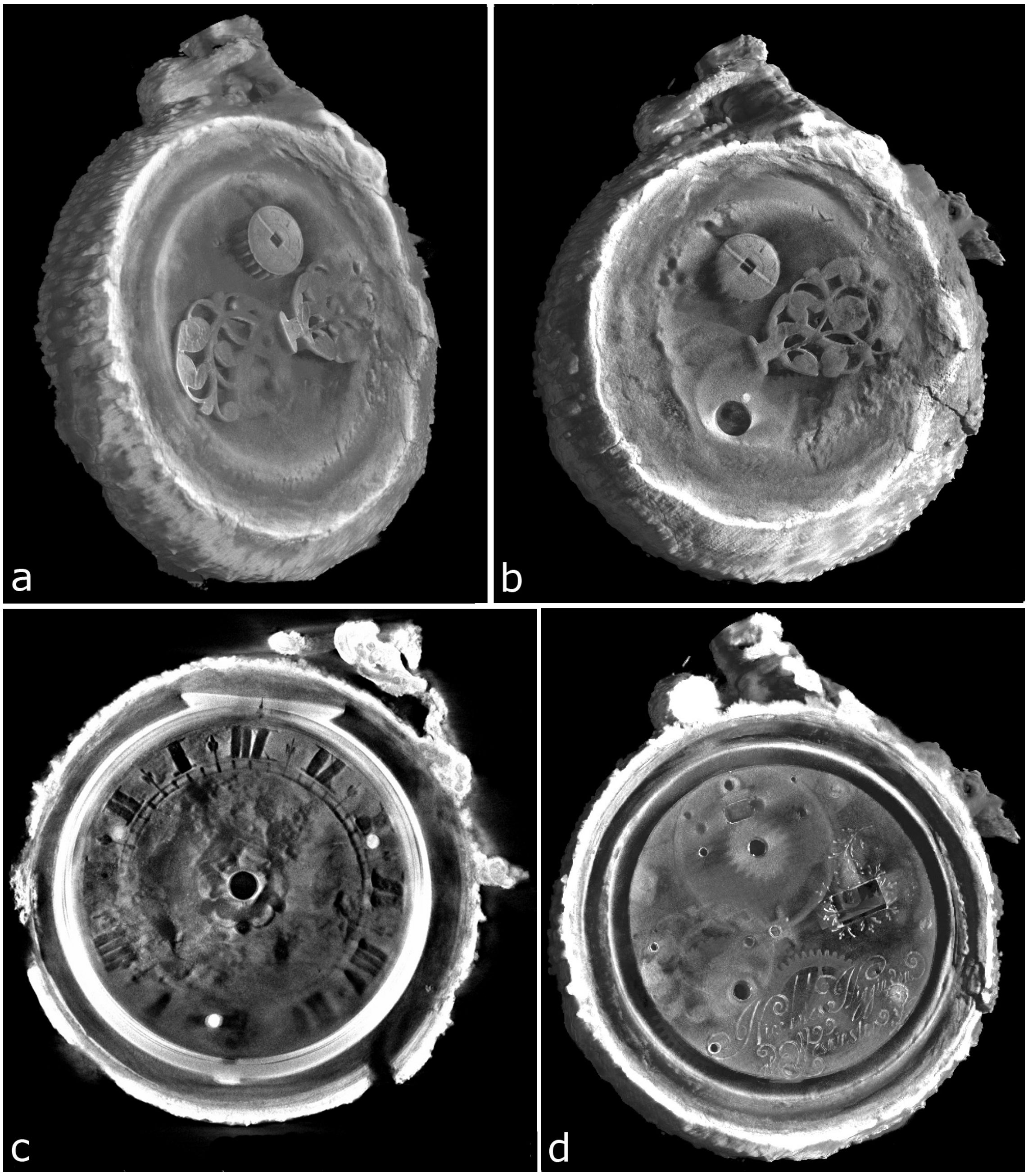


Illustration 258
(a) detail of 3D-CT image showing the regulation dial and the remain of its brass pin; (b) 2D slice through the 3D-CT volume, showing the engraving on balance back cock; (c) 2D-CT slice, showing the dial with rose engravings; (d) 2D-CT slice showing a floral engraving and the engraved signature: 'Niccholas Higginson Westminster' (all images © National Museums Scotland)

with an amorphous silicon flat-panel detector. The resolution obtained on the CT scan is voxel size of 63µm. The data were then reconstructed using X-Tec's CT-Pro Computed Tomography software and visualised using VolumeGraphics software. An Audiovisual Interleave animation (AVI) has been produced, showing a three-dimensional reconstruction of the watch and allowing a viewer to pass through the object from one side to the other and back again. This has important implications for the display and explanation of such objects.

The results of the investigation exceeded all expectations. The three-dimensional character of the scans, and the very high resolution, allow fine details to be seen. Images this fine might be resolved by conventional radiography, but they would be exceedingly difficult to interpret. The 3-D visualisation makes possible a virtual reconstruction of the mechanism, which confirms the date and origin of the watch (Troalen et al 2010) (Illus 257–8). The CT scans reveal that all the steel pieces appear to have decayed through corrosion, whereas the brasswork remains in fine condition. As a result it has not been possible to define ferrous pieces such as arbors, pinions, pallets or balance-wheels, which are traditionally made of steel. However, since the brass components remain fixed within the matrix of concretion, their original configurations are preserved, while corrosion-products of the steel and (to a lesser extent) the brass appear to fill the voids inside the movement. Using image-processing/-enhancing software it has been possible to observe a cloudy feature which could represent either this corrosion or some scattered X-rays. Within this some traces of the original ferrous metalwork can be observed. For example, parts of the iron spring-coils appear in the barrel, showing a typical corrosive angular pattern (Illus 257b).

Description

Around 1630 England produced a plain-looking watch now classified as the 'puritan' type, a style relatively free of decoration (Harris 1977: 36). The scans of the Duart Point watch suggest that the inner case is simple and undecorated. This need not, however, imply austere treatment, for by the second quarter of the century greater emphasis of decoration was often placed on the outer case, leaving the inner one plain. Because of corrosion and concretion the character of the Duart Point watch's outer case cannot be ascertained, although surface X-Ray Fluorescence analysis revealed the presence of silver in the chain and the watch's case suggesting that these were made of silver, or possibly silver-plated copper alloy (Wilthew 1994). This is an extremely high-status artefact for its period, and its presence (along with the snaphaunce pistol and gold-wound sword-hilt) implies an owner of considerable wealth and high social standing. The most likely candidate is the ship's captain, Edward Tarleton.

The watch has a single train movement with verge escapement typical of the period. Until the invention of the Virgule Escapement in 1660 the verge and crown-wheel was the only escapement used in watches (Britten 1904: 529). The wheels are so clearly visible that the teeth can be counted (Illus 257d). It was not uncommon at the time of manufacture for all the brass pieces to be gilded, which could possibly explain the relatively good preservation of most of the non-ferrous parts. It is not possible, however, to determine whether or not gilding is present, as the thickness of the gold layer would be much less than the resolution achievable with the CT scan.

On the top plate there is evidence of a worm-and-wheel set-up, a system for regulating the time via the spring. What remains of this is an engraved dial numbered 1 to 8 in Arabic numerals and the regulation wheel beneath it. The steel square, attached to the centre of the spring and linked to the regulation wheel, which would have been used to adjust spring tension, appears to be missing, but the 'ghost' of the brass pin used to secure the dial remains as a void in the corrosion products (Illus 258a). The regulation dial indicates the amount of tension on the spring, which would adjust the rate (time-keeping) of the watch. Around 1610 the worm-and-wheel replaced the ratchet as the regulator of a watch (Baillie 1929: 87), so the presence of this feature suggests that this watch was made after this date. The top and bottom plates are held together by square-sectioned Egyptian tapered pillars (Illus 257b), a style introduced *c* 1640, which brings the typological dating closer to the middle of the century (Britten 1904: 529).

Contemporary watches commonly have floral engraving in areas such as the dial and top-plate. By rotating the virtual reconstruction of the watch and looking at specific two-dimensional projections it has been possible to record detailed images of engraved parts, even though these are no more than fractions of a millimetre deep. There are floral engravings around the aperture for the verge pallets/crown wheel. Some floral engravings which define the pierced balance-cock can be seen (Illus 258b). These types of engraving are common in this period as watch decoration. The dial has a 12-hour chapter-ring in Roman numerals, with quarter-hour graduations and half-hour decorative symbols, which may be fleurs-de-lys, though this cannot be judged with certainty from the image (Illus 258c). An English rose surrounds the central hole. There would have been only one hand on a watch of this date, and this hand has unfortunately completely corroded away.

Engraved on the top-plate in copperplate script are the words 'Niccholas Higginson of Westminster' (Illus 258d). Loomes (1981: 300) notes that a Nicholas Higginson of London was granted the freedom of the Clockmakers' Company in 1646. He rebelled against them in 1656 and was working in Chancery Lane (in Westminster not the City of London) by 1662. He paid a search fee in 1671. Freedom of the Clockmakers' Company was required in order to trade in the City of London, and was only granted after serving an apprenticeship. Rebelling against the Clockmakers implies that Higginson had refused to pay his membership dues in 1656. This did not evidently free him from all his former responsibilities, however, for the fee paid in 1671 was a fine for deficient work found during one of their 'searches' or periodic inspections. The Duart Point pocket-watch is the only known surviving example of this maker's work.