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Barrels have been found in the wreck of the Mary Rose. These include the skeletons of a rat, a frog and a dog.[125] The dog, an English Toy Terrier (Black & Tan), was between five months and two years in age, was found near the hatch to the ship's carpenter's cabin and is presumed to have been brought aboard as a ratter.[126] Nine barrels have been found to contain bones of cattle, indicating that they contained pieces of beef butchered and stored as ship's rations.[127] The bones of pigs and fish, stored in baskets, have also been found.[127] Musical instruments Two fiddles, a bow, a still shawm or dougaine, three three-hole pipes, and a tabor drum with a drumstick were found throughout the wreck. These would have been used for the personal enjoyment of the crew and to provide a rhythm to work on the rigging and turning the capstans on the upper decks. The tabor drum is the earliest known example of its kind and the drumstick is of a previously unknown design. The tabor pipes are considerably longer than any known examples from the period. Their discovery proved that contemporary illustrations, previously viewed with some suspicion, were accurate depictions of the instruments. Before the discovery of the Mary Rose shawm, an early predecessor to the oboe, instrument historians had been puzzled by references to "still shawms", or "soft" shawms, that were said to have a sound that was less shrill than earlier shawms.[128] The still shawm disappeared from the musical scene in the 16th century, and the instrument found on the Mary Rose is the only surviving example. A reproduction has been made and played. Combined with a pipe and tabor, it provides a "very effective bass part" that would have produced "rich and full sound, which would have provided excellent music for dancing on board ship".[129] Only a few other fiddle-type instruments from the 16th century exist, but none of them of the type found on the Mary Rose. Reproductions of both fiddles have been made, though less is known of their design than the shawm since the neck and strings were missing.[130] Navigation tools In the remains of a small cabin in the bow of the ship and in a few other locations around the wreck was found the earliest dated set of navigation instruments in Europe found so far: compasses, divider calipers, a stick used for charting, protractors, sounding leads, tide calculators and a logreel, an instrument for calculating speed. Several of these objects are not only unique in having such an early, definite dating, but also because they pre-date written records of their use; protractors would have reasonably been used to measure bearings and courses on maps, but sea charts are not known to have been used by English navigators during the first half of the 16th century, compasses were not depicted on English ships until the 1560s, and the first mention of a logreel is from 1574.[131] Barber-surgeon's cabin Along with the medical equipment were also personal items belonging to the barber-surgeon, including an expensive silk velvet coif identical to those worn by the members of the Worshipful Company of Barbers in this painting by Hans Holbein the Younger from 1540.[132] The cabin located on the main deck underneath the sterncastle is thought to have belonged to the barber-surgeon. He was a trained professional who saw to the health and welfare of the crew and acted as the medical expert on board. The most important of these finds were found in an intact wooden chest which contained over 60 objects relating to the barber-surgeon's medical practice: the wooden handles of a complete set of surgical tools and several shaving razors (although none of the steel blades had survived), a copper syringe for wound irrigation and treatment of gonorrhoea, and even a skillfully crafted feeding bottle for feeding incapacitated patients. More objects were found around the cabin, such as earcrops, shaving bowls and combs. With this wide selection of tools and medicaments the barber-surgeon, along with one or more assistants, could set bone fractures, perform amputations and deal with other acute injuries, treat a number of diseases and provide crew members with a minimal standard of personal hygiene.[133] Hatch One of the first scientifically confirmed ratters was "Hatch" a terrier and whippet dog crossbreed who spent his short life on the Mary Rose.[134][135] The dog, named Hatch by researchers, was discovered in 1981 during the underwater excavation of the ship.[136] Hatch's main duty was to kill rats on board the ship.[134] Based on the DNA work performed on Hatch's teeth, he was a young adult male, 18–24 months old, with a brown coat.[134][136] Hatch's skeleton is on display in the Mary Rose Museum in Portsmouth Historic Dockyard.[134] Conservation The Mary Rose being sprayed with water at the facility in Portsmouth in March 1984. Between December 1994 and July 1985 the steel cradle was gradually rotated to stand with the keel in an almost upright position.[137] Preservation of the Mary Rose and her contents was an essential part of the project from the start. Though many artefacts, especially those that were buried in silt, had been preserved, the long exposure to an underwater environment had rendered most of them sensitive to exposure to air after recovery. Archaeologists and conservators had to work in tandem from the start to prevent deterioration of the artefacts.[138] After recovery, finds were placed in so-called passive storage, which would prevent any immediate deterioration before the active conservation which would allow them to be stored in an open-air environment. Passive storage depended on the type of material that the object was made of, and could vary considerably. Smaller objects from the most common material, wood, were sealed in polyethylene bags to preserve moisture. Timbers and other objects that were too large to be wrapped were stored in unsealed water tanks. Growth of fungi and microbes that could degrade wood were controlled by various techniques, including low-temperature storage, chemicals, and in the case of large objects, common pond snails that consumed wood-degrading organisms but not the wood itself.[139] Other organic materials such as leather, skin and textiles were treated similarly, by keeping them moist in tanks or sealed plastic containers. Bone and ivory was desalinated to prevent damage from salt crystallisation, as were glass, ceramic and stone. Iron, copper and copper alloy objects were kept moist in a sodium sesquicarbonate solution to prevent oxidation and reaction with the chlorides that had penetrated the surface. Alloys of lead and pewter are inherently stable in the atmosphere and generally require no special treatment. Silver and gold were the only materials that required no special passive storage.[140] The hull of the Mary Rose being sprayed at the facility in Portsmouth while a technician services the system Conserving the hull of the Mary Rose was the most complicated and expensive task for the project. In 2002 a donation of £4.8 million from the Heritage Lottery Fund and equivalent monetary support from the Portsmouth City and Hampshire County Councils was needed to keep the work with conservation on schedule.[141] During passive conservation, the ship structure could for practical reasons not be completely sealed, so instead it was regularly sprayed with filtered, recycled water that was kept at a temperature of 2 to 5 °C (35 to 41 °F) to keep it from drying out.[142] Drying waterlogged wood that has been submerged for several centuries without preserved, the long exposure to an underwater environment had rendered most of them sensitive to exposure to air after recovery. 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The substance polyethylene glycol (PEG) had been used before on archaeological wood, and was during the 1980s being used to conserve the Vasa. After almost ten years of small-scale trials on timbers, an active three-phase conservation programme of the hull of the Mary Rose began in 1994. During the first phase, which lasted from 1994 to 2003, the wood was sprayed with low-molecular-weight PEG to replace the water in the cellular structure of the wood. From 2003 to 2010, a higher-molecular-weight PEG was used to strengthen the mechanical properties of the outer surface layers. The third phase consisted of a waterlogged air drying ending in 2016.[143][144] Researchers are planning on using magnetic nanoparticles to remove iron in the ship's wood to reduce the production of harmful sulfuric acid that is causing deterioration.[145] The wreck site is legally protected. Under the "Protection of Wrecks Act 1973" (1973 c. 33) any interference with the site requires a licence. The site is listed as being of "historical, archaeological or artistic importance" by Historic England.[146] Display Main article: Mary Rose Museum Concept plan of the new Mary Rose Museum by Wilkinson Eyre Architects After the decision to raise the Mary Rose, discussions ensued as to where she would eventually go on permanent display. The east end of Portsea Island at Eastney emerged as an early alternative, but was rejected because of parking problems and the distance from the dockyard where she was originally built. Placing the ship next to the famous flagship of Horatio Nelson, HMS Victory, at Portsmouth Historic Dockyard was proposed in July 1981. A group called the Maritime Preservation Society even suggested Southsea Castle, where Henry VIII had witnessed the sinking, as a final resting place and there was widespread scepticism to the dockyard location. At one point a county councillor even threatened to withdraw promised funds if the dockyard site became more than an interim solution. As costs for the project mounted, there was a debate in the Council chamber and in the local paper *The News* as to whether the money could be spent more appropriately. Although author David Childs writes that in the early 1980s "the debate was as a fiery one", the project was never seriously threatened because of the great symbolic importance of the Mary Rose to the naval history of both Portsmouth and England.[147] Since the mid-1980s, the hull of the Mary Rose has been kept in a covered dry dock while undergoing conservation. Although the hull has been open to the public for viewing, the need for keeping the ship saturated first with water and later a polyethylene glycol (PEG) solution meant that, before 2013, visitors were separated from the hull by a glass barrier. By 2007, the specially built ship hall had been visited by over seven million visitors since it first opened on 4 October 1983, just under a year after it was successfully raised.[148] A separate Mary Rose Museum was housed in a structure called No. 5 Boathouse near the ship hall and was opened to the public on 9 July 1984,[149] containing displays explaining the history of the ship and a small number of conserved artefacts, from entire bronze cannons to household items. In September 2009 the temporary Mary Rose display hall was closed to visitors to facilitate construction of the new £35 million museum building, which opened to the public on 31 May 2013.[150] The new Mary Rose Museum was designed by architects Wilkinson Eyre, Perkins+Will and built by construction firm Waringis. The construction has been challenging because the museum has been built over the ship in the dry dock which is a listed monument. During construction of the museum, conservation of the hull continued inside a sealed "hotbox". In April 2013 the polyethylene glycol sprays were turned off and the process of controlled air-drying began. In 2016 the "hotbox" was removed and for the first time since 1545, the ship was revealed dry. This new museum displays most of the artefacts recovered from within the ship in context with the conserved hull. As of 2018, the new museum has been visited by over 1.8 million people[151] and saw 189,702 visitors in 2019.[152] Objects of the Mary Rose See also Archaeology of shipwrecks – Study of human activity through the analysis of shipwreck artifacts Batavia - 1628 flagship of the Dutch East India Company Kronan - Swedish Navy ship of the 1670s List of longest wooden ships Mars - Swedish warship that was built between 1563 and 1564 Notes ↑ Rodger (1997), p. 153–156. ↑ Marsden (2003), p. 1; Rodger (1997), pp. 164–165 ↑ Marsden (2003), pp. 1–2; Rodger (1997), pp. 165–166. ↑ Rodger (1997), p. 221. ↑ Marsden (2003), pp. 2–5; see Maria Hayward, "The Flags, Fabrics" in Knighton and Loades (2009), pp. 31–33 for a more detailed account of the making of the flags. ↑ Marsden (2003), p. 51. ↑ a b Damian Goodburn, "Woodworking Aspects of the Mary Rose" in Marsden (2009), pp. 66–68, 71. ↑ See for example McKee (1974), p. 4; Rodger (1997), p. 172; Rule (1983), p. 15; Weightman (1957), p. 286. ↑ a b Childs (2007), p. 17; David Loades, "The Mary Rose and Fighting Ships" in Marsden (2009), p. 5; Peter Marsden, "Reconstruction of the Mary Rose: her Design and Use" in Marsden (2009), p. 379. ↑ Marsden (2003), p. 90. ↑ Richard Barker, Brad Loewen and Christopher Dobbs, "Hull Design of the Mary Rose" in Marsden (2009), p. 36. ↑ For details of the construction, see especially Marsden (2009). ↑ a b Rule (1983), pp. 117–133; see Marsden (2009) for a detailed survey of deck design and construction. ↑ Peter Marsden, "The Upper Deck" in Marsden (2009), p. 216. ↑ Peter Marsden, "Reconstruction of the Mary Rose: her Design and Use" in Marsden (2009), pp. 371–378; Alexandra Hildred, "The Fighting Ship" in Marsden (2009), pp. 340–341. ↑ See for example Rule (1983). ↑ Marsden (2003), pp. 94, 96 ↑ Peter Marsden, "Propulsion, Masts and rigging" in Marsden (2009), pp. 242–249. ↑ Richard Endsor, "Propulsion, The rigging" in Marsden (2009), p. 261. ↑ Marsden (2003), pp. 7–8. ↑ Marsden (2003), p. 14. ↑ Loades (1992), pp. 94–95. ↑ Rodger (1997), pp. 205–206. ↑ Rodger (1997), p. 207. ↑ It was not until the 1590s that the word "broadside" in English was commonly used to refer to gunfire from the side of a ship rather than the ship's side itself; Rodger (1996), pp. 312, 316. ↑ Rodger (1996); Rodger (1997), pp. 206–208, 215. ↑ a b Alexandra Hildred, "The Fighting Ship" in Marsden (2009), pp. 297–344. ↑ Alexandra Hildred, "The Fighting Ship" in Marsden (2009), pp. 313–316. ↑ Based on tables in Marsden (2009), pp. 318, 332, 338, 341. ↑ a b The last record is the illustrated Anthony Roll, which was completed after the sinking, when it was apparently still believed that the Mary Rose could be raised and restored. ↑ a b Alexandra Hildred, "The Fighting Ship" in Marsden (2009), pp. 298–303. ↑ Based on table in Marsden (2009), p. 302. ↑ Rule (1983), pp. 149–168; David Loades, "Il: The Ordinance" in Knighton and Loades (2009), pp. 12–14; Alexandra Hildred, "Hull Munitions" in Knighton and Loades (2009), pp. 16–19. ↑ Alexandra Hildred, "The Fighting Ship" in Marsden (2009), pp. 311–312, 341. ↑ Childs (2007), p. 57; see also BBC News, "Sword from Mary Rose on display", 26 July 2007. ↑ Rule (1983), p. 172; Stirland (2000), p. 21. ↑ Rule (1983), pp. 181–182. ↑ Alexandra Hildred, "The Fighting Ship" in Marsden (2009), pp. 324–325; see also Balfour, Metcalf & North, "A Gun-Shield from the Armoury of Henry VIII:Decorative Oddity or Important Discovery? 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