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Elizabethan Merchant Ships and Shipbuilding Transcript

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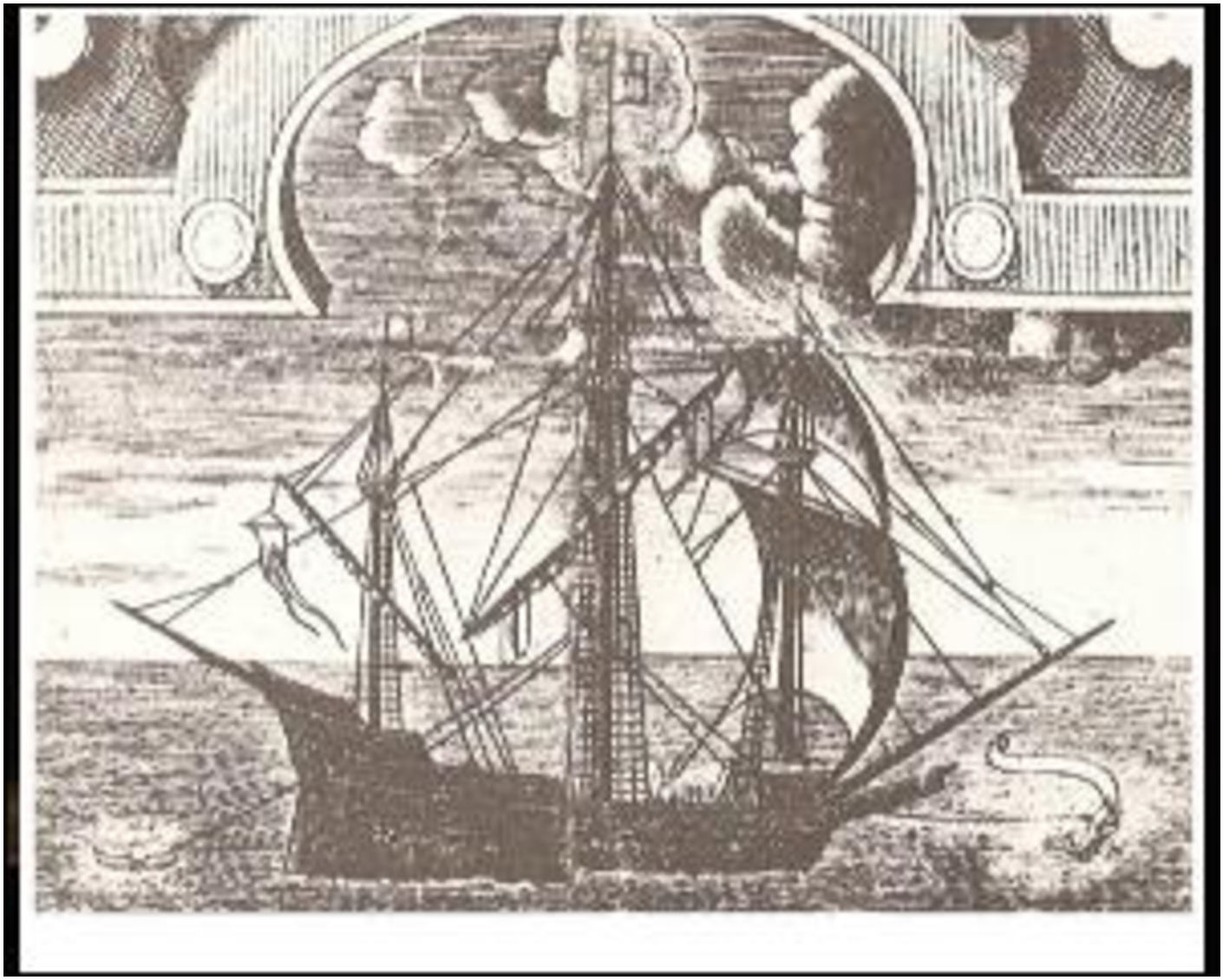

Elizabethan Merchant Ships and Shipbuilding

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The traditional story of Elizabethan seafaring is dominated by Sir Francis Drake, galleons, the Armada, John Hawkins, Martin Frobisher, and, not forgetting, of course, Sir Francis Drake. I am not for a moment underestimating the importance of these people, events and things, but I do feel that we need to look a lot more closely at the world of which they were a part.

Elizabethan England was not the maritime superpower that subsequent myth has made it, but the Elizabethan era saw the nature of English seapower change considerably. This was seapower in terms of naval force, but also in the wider senses of the nation's ability to build and maintain a merchant fleet, conduct trade and open new routes to distant places.

England already had an effective royal fleet when Elizabeth came to the throne. Despite many problems, the navy grew stronger during her reign, as did the merchant fleet. The English sea trading network began to widen from the 1550s. Until that time, the dominance of the cloth trade route between London and Antwerp had led to the decline of other aspects of the country's maritime economy. As the Antwerp market collapsed, merchants had to start looking for new trade-routes and sources of wealth. By 1600, English ships were routinely sailing to the Americas and into the Mediterranean, on voyages of trade or privateering, or both, and the first attempts were being made to break into the valuable spice trade in Asia.

This growing sea power meant that in the 1585-1604 war with Spain, England was able to fend off invasion, carry the war to Spain and its colonies, and pose a real threat to Spanish shipping. However, in terms of population, economy and military power, England was dwarfed by the might of Spain: at best, it could only last out the war, not win it.

The Queen's 'navy royal' was the spearhead of English sea power, but it was never a large force and did not have a permanent body of sea officers and mariners. As a consequence, the royal fleet relied on the 'merchant navy' for manpower and ships. Any large naval operation needed the support of merchantmen as additional warships, stores carriers and troop transports. In 1588, out of about 226 English vessels mustered to face the Armada, only 34 were Queen's ships. The rest belonged to her subjects.

Although this lecture is about 'Elizabethan merchant ships', it should be stressed that a 'merchant' ship of the period was not always built or used for trade alone. Many ships were made ready to fight, either in self-defence, or to attack other vessels in acts of piracy, privateering or war, or to take part in naval expeditions. Trying to draw a neat line between a trading vessel and a fighting ship can be almost impossible at this period, for even very small ships could go to war. The 14-ton *Swallow*(described as a 'small bark' and 'very old'), arrested by the English High Court of Admiralty in 1586, was able to carry a couple carriage-mounted falconets, each weighing over 250 kg each, together with two swivel guns, 118 shot and a dozen pikes. Although little bigger than a contemporary fishing boat, the *Swallow* had evidently not been out fishing - at

least, not for fish.[1]

The basic construction and rig of Elizabethan ships

English ships of the period were all carvel-built (also now known as skeleton construction). Carvel shipbuilding began with the laying of a keel, to which were attached the stem and sternpost, followed by a skeleton of frames and beams. The planks were then nailed to the frames, flush-laid against each other. This form of construction had been developed in the medieval Mediterranean, and had been adopted for the construction of most seagoing vessels in northern Europe by the first half of the 16th century, supplanting clinker construction for all but the smallest craft.[2]

The idea of sheathing hulls as a protection against shipworm attack was certainly known in the Elizabethan period. Thin lead sheathing was apparently used on the ships of Willoughby and Chancellor's 1553 expedition to discover the north-east passage. Seventy years later, it was said that thin boards, backed with tar and hair, were often used to sheath hull planks, especially on ships sailing to warmer waters.[3]

The 'typical' English ship of the 16th century was a three-master, with square canvas sails on the bowsprit, fore and mainmasts and a lateen sail on the mizzenmast, towards the stern, often with square-sailed topmasts on the fore- and mainmasts. This sort of rig gave a kind of manoeuvrability to vessels that was not available with two-masted or one-masted rigs. That said, as will be shown, two-masted and single-masted ships also existed in some numbers.

The design of English merchant ships

In about 1586, the Elizabethan royal master shipwright Matthew Baker compiled a manuscript on aspects of ship design now known as 'Fragments of Ancient English Shipwrightry'.[4] The main thrust of the manuscript was to demonstrate the importance of using mathematics and geometry in ship design; it also suggested design methods that could be used by 'unlearned' shipwrights without mathematical knowledge. Baker had travelled to the Mediterranean in his youth, and appears to have absorbed many Mediterranean ideas about ship design.[5]

Baker noted that earlier master shipwrights used 'certain rules of proportion, but not such as agreed with art' (i.e. mathematics). There was probably a lot more of this approach in Baker's own work than he would have been prepared to admit. It is likely that most English shipwrights of his day still based their designs on the proportional relationships between keel length, breadth and so-on, modifying them according to their own experience.[6] Much of this was probably unwritten and there is some indication of quite how 'unlearned' the majority of shipwrights were. Out of 45 shipwrights appraising ships for the High Court of Admiralty between 1579 and 1590, just fourteen could sign their names.[7]

The only general information on the relative proportions of Elizabethan ships comes from a paper written in 1592 by the Comptroller of the Navy, William Borough.[8] The width or beam of the vessel at the midships section was the key dimension in ship design. The keel length and depth in hold (depth from a line taken across the widest point of the ship to the bottom of the keel) were expressed in relation to the beam. The shape of the midships section played a critical role in determining the shape of the ship.

The handful of surviving merchant ship dimensions from the period show proportions that lie mostly within Borough's first and second categories. It would appear that he was describing the real situation, rather than merely offering desirable objectives.[9]

Keel, beam and depth in hold dimensions were also used for determining tonnage. The principal Elizabethan method for calculating tonnage was laid down in 1582 by Matthew Baker, although he may have been codifying existing practice. For merchant ships, the key figure was to work out how much a ship could carry, measured in terms of the capacity of the wine tun or barrel of 252 gallons. This measure of capacity, 'tons burden', had originated in the medieval Bordeaux wine trade, and continued in use.

Baker's Old Rule, as it came to be called, was very simple:

$$\frac{\text{Keel x Beam x Depth in Hold}}{100} = \text{tons burden, or carrying capacity}$$

To give a measure of deadweight tonnage, or 'tons and tonnage' (to account for the weight of crew, stores, fittings, armament, etc.), a figure of one-third was added to the tons burden.

Designing and ordering ships

The processes by which Elizabethan merchant vessels were specified and designed are opaque, to say the least. There is some evidence that paper plans or models, were being produced for the design of non-royal ships. This relates to the *Edward Bonaventure*, built at Rochester on the Medway in about 1574 for a London merchant of the Levant Company named Thomas Cordell. Richard Madox, who voyaged on the ship in 1582, notes that 'the galleon was moulded by M Baker and framed by John Ady', and that its design was based on that of the Queen's warship *Foresight*. Baker and Ady were royal master shipwrights and close personal friends, but the reference to 'moulded' and 'framed' shows the beginnings of a distinction between the person designing a ship, and the person who actually built it.[10]

Very few shipbuilding contracts seem to have survived from the period, and those that do exist often seem to be a mixture of precise detail and utter vagueness. For example, in 1609, a Rye shipwright contracted with three local fishermen to build a bluff-bowed vessel, measuring 52½ ft from stem to stern, and 16½ ft in breadth (16 x 5 m). The document included a fair degree of detail about the decks, and even structural members, but omitted major details such as the number of masts it was to have. The ship was to cost £100, £30 paid at the signing of the contract, £60 before launching and the remaining £10 'at the day of launching of the said ship'.[11]

Shipwrights

In medieval England, shipbuilding was a relatively low-status trade with a weak craft structure. Shipwrights appear to have been relatively few in number, for the most part spread thinly around the country, with concentrations in only a few centres.[12]

This situation seems to have changed in the 16th century. As suggested by Brian Dietz, at least part of the

reason for this was the development of the Tudor royal dockyards, particularly those on the Thames. [13] The need to keep the fleet in being during the 16th century and beyond meant that most of the navy's shore facilities stayed in operation, unlike their medieval predecessors.[14]

The Tudor royal dockyards certainly created a demand for shipbuilders: in the first quarter of 1559, for instance, the yards at Deptford Woolwich and Portsmouth were employing 520 shipwrights between them. Royal master shipwrights became people of real significance, helping to raise the status of the craft as a whole. The granting of a royal charter to the Shipwrights Company in 1605 was a sign of this changed status, elevating a craft which had hitherto been organisationally weak. Appropriately enough, Matthew Baker became its first Master.[15]

We know very little about most Elizabethan shipwrights, apart from the royal master shipwrights like Baker and Peter Pett, and even they are quite shadowy figures. However, it would be wrong to think of these men as some sort of separate group of specialised naval constructors. They were able to undertake private work, and a few became very rich. Baker's old friend John Ady left bequests worth just over £513 in his 1605 will.[16]

Some shipwrights in other parts of the country could also make a good living. Nicholas Sampforde, of Lyme Regis in Dorset (d 1594), for example, owned several houses and some land. His contemporary, William Pynder of King's Lynn in Norfolk, was also a man of property, with a big house, gardens, orchards, yards and warehouses close to the waterfront. [17]

Investment in the late Elizabethan shipping industry seems to have been mostly restricted to merchants, seamen and shipwrights. To judge from the records of ships granted a royal bounty for ship construction, only a minority of shipwrights were rich enough to become shipowners.[18]

Shipbuilding workforces in the smaller coastal towns were probably never very large, nor very wealthy. For example, in the Sussex port of Rye, a local tax assessment of 1576 listed only a dozen shipwrights, out of 416 taxpayers, who between them had less than 2% of the assessed wealth.[19]

Shipbuilding had a craft structure, like any other trade, with servants and apprentices at the bottom and masters at the top, although there were some building projects that lacked an obvious master in overall charge (see below). The craft structure of medieval shipwrightry had been conditioned by the technology of clinker ship construction.[20] The medieval terminology persisted in government initiatives to control wages, even if most seagoing vessels were now carvel-built. The 1563 Statute of Labourers talked of 'master hewers' 'clinchers' and holders. It also referred to master caulkers and apprentice caulkers, and recognised two levels of skill in all crafts, 'the chief sort' and 'the second sort'.

Shipwrights at Rye were perhaps better paid than some of their contemporaries (Rye was claimed to be an expensive place when compared to anywhere else in Sussex), but as Mayhew has observed, the local version of the Statute of Labourers, issued in 1563, listed them among the day-labourers, rather than those paid at an annual rate. Day-labouring was always more precarious.[21]

The daily pay rates for shipwrights at Rye in 1563 (and 1566), without food and drink being supplied to them, were:

Craftsman	Chief Sort	Second sort
Master hewer	18d	12d
Able clincher	15d	12d
Holder	10d	12d
Master caulker	18d	12d
Apprentice shipwright	5d	-

To give some kind of comparison, a sawyer who cut 100 boards was paid 20d a day, and a brickmaker who made who dug the clay for 1,000 bricks and cut and baked them was paid 24d.

The supply of shipbuilding materials

Timber and iron were the vital raw materials for ship construction. Unfortunately, there is only limited direct evidence as to where Elizabethan shipwrights got their supplies, although there are no signs that they suffered serious shortages. Medieval shipbuilding accounts show that a good deal of timber was cut for specific shipbuilding projects, and used green. It seems probable that this situation continued into the 16th century. The Tudor navy could call on a range of sources of timber, including trees cut down in royal parks and woods, but it is far less clear how sources of supply were organised for non-royal shipbuilding.[22]

The account for the construction of the Rye pinnace in 1587-88, one of the few non-royal Elizabethan shipbuilding accounts extant, suggests that the timber came from local sources. Nationally, the Baltic became an increasingly important source of materials for shipbuilding. Timber, boards, masts, canvas, pitch, tar, hemp, cordage and other materials used in the industry were imported in growing quantities from Danzig and other places.[23]

Canvas production did get off to a shaky start in England from the mid-16th century, with Ipswich and Woodbridge emerging as centres of production, but imports of this strategic material continued, both from the Baltic and from France. Rope had been made in England since the Middle Ages, but was also imported in significant quantities. Writing in the early 1620s, the author and retired pirate Sir Henry Mainwaring, not always a fan of English shipbuilding techniques and materials, rated Mediterranean cables best, 'the next, the Flemish and Russian; the last, ours'.[24]

Shipbuilding sites and shipbuilding technology

Medieval shipwrights seem to have chosen their building sites on a rather haphazard basis, and there are signs that their Tudor successors were much the same. For example, at Southampton, in 1573, there were complaints that the activities of shipbuilders were creating navigational hazards close to the West Quay and the Watergate. Shipwrights were digging docks for building ships, and then leaving them unfilled once the work was finished.[25]

Identifying specific, long-term 'civilian' (i.e. non-royal) shipyards is not easy in the Elizabethan period. Even in the traditional seafaring parishes east of the Tower of London (Ratcliffe, Wapping and Limehouse), there is evidence of shipwrights, but seemingly little to show exactly where they worked or if any of them owned actual yards.[26] It may be that evidence of shipbuilding yards of some permanence will emerge from the study of property records from around the country. For example, in 1607 the Hull shipwright Joseph Blaydes leased some ground near the city. It was outside the North Gate, adjacent to the port, and was evidently intended for a shipyard.[27]

The methods used for building and launching ships were probably much the same as those use in the Middle Ages, ranging from a simple river bank launch to, in some cases, the use of drydocks.[28] Many contemporary illustrations of shipbuilding scenes show hulls under construction, propped up with shores.[29] However, none of them appear to give clear evidence of fixed slipways. When the Rye pinnace was launched in 1588, the operation required a mere four shipwrights and four pounds of soap, the latter presumably to ease the vessel's passage into the water.[30]

The shipbuilding process

Although the design and construction of Elizabethan royal warships is moderately well documented, only one detailed shipbuilding account appears to exist for a non-royal vessel, the pinnace built for the town of Rye in 1587-88.[31] This was a vessel of about 25 tons, built for service against the Spanish, so it does not seem to have been a merchantman. However, the account for building it is evidence of the construction process in a local yard, far outside the orbit of the royal dockyards. The total cost of the work and materials for this small ship was just over £64, although for some reason the account omits any mention of iron nails and ironwork.[32]

Work on the ship began in early October 1587, and the hull and superstructure took about twelve weeks to complete. Even a small hull could absorb prodigious quantities of materials, and at least 2,275 trenails were used in the pinnace, together with over 131 lb (59.5 kg) of oakum for caulking (old rope threads unpicked and re-spun for caulking).

Work stopped in early January, for reasons unknown, and nothing more was done until 12 April, when it was launched. Payments for masting, sailmaking and rigging followed in the period up to 10 May, suggesting that, as in the Middle Ages and later periods, fitting-out followed the launch.

The shipwright team was small, never exceeding more than nine in any one week.

At least two of them seem to have been French Huguenots, many of whom were then resident in Rye. The working week could last for up to six days, but in practice could vary from one to six. Another peculiarity of the project (although one sometimes encountered in medieval shipbuilding accounts)[33] was the absence of any obvious master shipwright. Daily pay rates for the majority of the men ranged between 20d and 2s per day, but several men were paid at the 2s rate, with no obvious top earner. One can only speculate as to how matters of design and working practice were sorted out.

The quality of English shipbuilding

It is very difficult, if not impossible, to arrive at any judgment of the overall quality of Elizabethan shipbuilding. Building for the navy seems to have been very competently handled. Many royal ships lasted for decades, and very few were ever lost as a result of combat or even wreck.

There are some isolated pieces of evidence pointing to poor workmanship in merchant shipbuilding, however. The 'Gresham Ship', recently discovered and raised from the Thames, was an English ship constructed soon after 1574, most probably in East Anglia. Its remains revealed evidence of a practice known as 'furring', that is, taking off the outer planking in order to increase the breadth of a ship by doubling the frames. Furring seems have been used to correct poor design, when a ship had been built too narrow, and was unstable. Sir Henry Manwaring had harsh words to say about English shipwrights:

'I think in all the world there are not so many ships furred as in England, and it is a pity that there is no order taken either for the punishing of those who build such ships or the preventing of it, for it is an infinite loss to the owners and an utter spoiling and disgrace to all ships that are so handled'.[34]

A modern reconstruction by Brian Lavery of the English merchantman *Susan Constant* of 1605, based on late 16th and early 17th-century design practice, indicated that the maximum width of the vessel amidships would have been underwater. Lavery quotes a report of 1626 that suggests some merchant ships were actually built in this unstable and dangerous fashion.[35] Clearly, not every English shipwright of the time was another Matthew Baker.

The numbers and sizes of merchant ships

Thanks to the Elizabethan government's preoccupation with national defence, for the first time in English history we can begin to get some idea of how many ships there were in England, and how big they were.

A partial national survey of 1560 listed 76 ships of 100 tons and more, with very few of 200 tons. The 1577 survey counted 135 vessels in the 100 tons and upwards range, along with 656 ships craft of between 40 and 100 tons and 'an infinite number' of small barks.[36]

The 1582 survey was the most comprehensive, the figures breaking down as follows:

Tonnage range	**Number of ships**
10-80 tons	1,204 (82.8%)
80-100 tons	73 (5.0%)
More than 100 tons	178 (12.2%)
Total	**1,455**[37]

Renditions of these figures vary, but the overall messages are fairly clear: just under 90% of the country's merchant fleet was of 100 tons or less in the early 1580s, but the actual number of larger ships had increased significantly in the twenty years or so since Elizabeth's accession.

The reason that the 100-ton figure features so much in discussions of Elizabethan merchant shipping is because since the 15th century, English governments had regarded 100 tons as the smallest useful size for a merchant ship that could be put into naval service. The government paid a bounty on the building of ships 100 tons and more in order to encourage their construction. Trade and privateering probably provided a greater incentive to build such ships than these government initiatives. Bigger ships could carry more cargo, along with more crew and weapons, making them better-fitted to survive on long-distance routes to the Mediterranean and across the oceans. The statistics for the bounty grants are partial, and probably affected by endemic Elizabethan problems such as corruption, but, like the shipping returns, for the first time in our history they give an indication of the distribution and capabilities of the shipbuilding industry.

Between 1560 and 1610, the bounty was paid on the construction of 510 vessels, 126 (totalling 22,843 tons) in the period 1560-1588, and 384 (totalling 88,604 tons) in the years 1589-1610. Even allowing for under-recording in the earlier period, there are clear signs of an absolute and considerable increase in the number of bigger ships built, particularly from the mid-1590s. It has been suggested that the sudden increase in the grants was due to a policy change, rather than external factors. However, I feel that a more likely explanation is that shipowners were now demanding larger, 'defensible' ships, first for wartime privateering during the Spanish war and later, for the long-distance routes once peace returned. The lure of privateering during the war should not be underestimated, as it promised great wealth, if seldom delivered any. For example, it has been estimated that at least 80 privateering voyages left England in 1598 alone.[38]

The 1589-1610 figures demonstrate the extent to which the London, the Thames, Essex and Suffolk had come to dominate the English shipbuilding trade by the early 17th century. Out of 384 ships, 222 were built at London or elsewhere on the Thames (over 56% of the total tonnage), with a further 95 vessels (just under 26% of the tonnage), emerging from shipyards in Suffolk and Essex. In total, the region was producing more than four-fifths of the recorded bounty tonnage in this period, no doubt due mainly to the financial clout and aspirations of the London merchants.

The overall bounty figures also show a great increase in the numbers of ships in the 200-400 ton-range, with two-thirds (255) coming into this category. It is clear that the national fleet not only grew considerably in the late Elizabethan period, it also now contained many more large ships.

However, it is easy to concentrate too much on the bigger Elizabethan ships, forgetting that most of the coastal and short-range overseas trade went in the smaller vessels. As late as 1600, the average size of English ships involved in London's foreign trade was only about 80 tons.[39]

The evidence of High Court of Admiralty appraisals:

a key source for merchant shipping

The English High Court of Admiralty (HCA) was responsible for civil and criminal matters relating to the sea, including piracy, the taking of prize ships and collision. It routinely seized ships as part of its business, and had them appraised by shipwrights, sailors and other experts. These records contain numerous inventories and valuations of non-royal ships. They are an unrivalled source of information for merchant and other private shipping.

A study of 119 ships arrested in the 1579-90 period gives some idea of the potential of this material.[40] Of this group of ships, the immediate origins of 82 are known, by reference to their home port or country. Forty of them were English, but of the remainder, 22 came from the Low Countries (Holland and Flanders), eight from the Spanish Empire, seven from France and Brittany, four from Germany and one from Denmark. This immediately begs the question as to the value of the HCA appraisals in understanding *English* merchant shipping of the period. The answer is, that many of the arrested vessels probably ended up in the hands of English owners once they had passed through the Court's hands. It is clear that numerous ships changed hands between different countries, either legally or through the actions of pirates and privateers.[41] One ship seized by the Court in 1586, the 80-ton *Jonas* of Antwerp, had previously belonged to the port of Rouen in Normandy.[42] English merchant shipping was not just English.

Fifteen different types were represented in the appraisals. Of these, only three types exceeded 50 tons. These were:

Type	**Number in group**	**Minimum recorded tonnage**	**Maximum recorded tonnage**
Flyboat	10	35	160
Galleon	1	-	120
Ship	50	20	200

The tonnages of only 32 of the ships were recorded, but of these, 25 were of more than 50 tons burden.

The most numerous of the smaller types were barks and hoys, all of which were of 50 tons or less, where their tonnages were noted. The smallest vessels in the group seem to have been fishing vessels, two 'catches' of eight or nine tons, and a Thames peterboat of ten tons.

Many of the appraisals record numbers of sails or masts, making it possible to determine the types of rig. The results were as follows:

No of masts		
1	2	1
2	16	10
3	37	2
4	1	
Totals	**56**	**13**

It is clear that whilst the three-masted rig was the most common in this group, two-masters were also

significant (most of the 'probable' two-masters were hoys from the Low Countries). Small numbers of three-masted barks, canters[43], crayers and flyboats were recorded, but twenty-three of the three-masters were described as 'ships'. This tendency to identify three-masted rig with 'ships' may help to explain why it was later known as 'ship rig'.

About half of the arrested ships had weapons, the proportion increasing from the mid-1580s onwards, when the war with Spain began. Armed merchantmen and privateers were part of the country's naval defence, and large numbers were mobilised during the war. However, the appraisals make it very clear that the general run of private ships, whether merchantmen, privateers or pirates, could not hope to match the firepower of Elizabeth's great warships. Demi-culverins, culverins (9 - 18 pound shot) and larger weapons were the mainstays of the royal galleons, but the commonest guns recorded in the HCA appraisals were falconets, falcons and minions (about 1½ - 4 pound shot), with a few six-pounder sakers. That said, in a war typified by naval expeditions, raids, small-scale actions and privateering rather than big battles, armed non-royal vessels could be of considerable use.

Some of the appraisals contained estimates of ships' ages in years, although many were merely described as 'old' or 'very old'. The numerical ages have to be treated with a degree of caution, partly because it is not clear how they were found out, and partly because the appraisers may have had a tendency to reckon that bigger ships were also older ships! However, it does seem reasonable to suppose that these represented what were regarded as feasible ages for ships of the period. The results for these were:

Age in years	**No in group**
0-4	2
5-9	7
10-14	10
15-19	12
20-24	5
25	2
50	1

The results suggest that the appraisers thought it quite possible for a significant number of ships to last between ten and twenty years. If this reflected the general situation, it would have meant that the considerable capital costs involved in building a ship would have been easily defrayed over the course of its service life.

In 79 cases, the total value of a vessel (including rigging, armament and other equipment) can be matched against tonnage.

Value per ton	**No of ships**

Less than £1	43
£1 - £1/10s	21
£1/10s - £3/10s	14
£6/16s	1

Where estimates of age were given, whether numerical, or a description such as 'old' or 'very old', there was no clear correlation between age and value. One of the most valuable ships appraised was the 140-ton *George Bonaventure* of London: it was reckoned to be 23 years old. [44] An old ship could clearly still hold its value if well-built and carefully maintained. Conversely, the figures suggest that the majority of ships eventually declined to a low level of value, at which they remained for some time before finally going out of service.

Whatever merchant ships were worth, they were usually worth a lot less than their cargoes. This is one of the things that could make investment in shipping so profitable for shipowners and merchants. For example, an old, 35-ton Dunkirk flyboat, seized in 1588, was reckoned to be worth a mere £15, but its cargo of cloth and other goods was put at £827, some 56 times more valuable than the vessel that carried it.[45]

The internal structure and equipment of merchant ships

The evidence for the layout of merchant ships is limited. The clearest descriptions come from Mainwaring's *Seaman's Dictionary* of the early 1620s, and these are the basis for much of what follows here.[46]

A large, three-decked ship had the hold in the bottom of the hull, which was divided into 'rooms', using bulkheads. The hold, as one might expect, was used for the stowage of ship's stores, victuals and cargo. When cargoes such as grain (that was liable to shift) were stowed, additional bulkheads called 'pouches' would be built in an effort to prevent cargo movements from destabilising the ship.

In a three-decked ship, the two decks above the hold might be called 'orlops'. The orlops could be used for stowage, but also served for accommodation. The ship's superstructure stood on the third deck, and consisted of a forecastle at the bow, and a half deck, running from the mainmast to the stern. The mainmast provided the age-old demarcation line between the boatswain and common sailors, who lived before the mast, and the master and other officers, who lived aft of it.

The steersman's station would be on the half-deck, along with the master's cabin. The master's cabin was normally under the poop deck, the highest point of the superstructure. Access to the hold was via a hatchway in front of the mainmast, but smaller hatches, called scuttles, also gave access to all decks for the crew.

The normal position of the cook room in a merchantman of the period is less certain, due to lack of evidence. The cook-room in Henry's warship*Mary Rose*, lost in 1545, was in the bottom of the hold, just forward of the mainmast.[47] Mainwaring said that a merchant ship normally had its cook-room in the forecastle, to free up

hold space. Warships, he states, usually had their cook-rooms in the hold, for tactical and other reasons, but he also points out that the heat of cooking in the hold could ruin stored victuals.

Cooking facilities on ships were probably rudimentary, consisting of a brick hearth or perhaps a furnace, but sea-cooks could do more than just boil victuals. The 1580s HCA appraisals record griddles and frying-pans aboard ships, suggesting that it was possible to toast, grill or fry food at sea. That said, a cook-room set in the hold could have been very unhealthy; aside from the heat spoiling victuals, there was the ever-present threat of contamination posed by stinking bilge-water and filth mixed in with the ballast. Instructions for Willoughby and Chancellor's 1553 voyage included the following strict injunction:

'Item, no liquor to be spilt on the ballast, nor filthiness to be left within board: the cook room, and all other places to be kept clean for the better health of the company" [48]

Sleeping arrangements for ordinary sailors were probably haphazard. Hammocks were officially introduced into naval use in 1597, but may not have been common in merchantmen.[49]

There is not space here to discuss details of the rigging, but there is an interesting question regarding the method of steering ships at this period. At some point in the 16th or early 17th centuries, the whipstaff was invented. This was a vertical, pivoted pole, attached to the end of the rudder bar at its lower end, and passing through to the deck above, where the steersman stood. By moving the whipstaff to left or right, it was possible to move the rudder. The 'whip' is mentioned by Mainwaring, who says that it was not used in bigger ships, because a single steersman could not cope with the forces exerted by a large rudder. There is some incidental evidence to suggest that a whipstaff was being used in an English merchant ship as early as 1581.[50]

The operation of ships

A question often asked about old sailing ships is, how fast did they go? Sixteenth century sailors certainly liked a ship to be able to sail fast and manoeuvre well, but it is likely that the performance of many ships hovered around a low common denominator. The problems for all sailing ships, throughout history, are that a vessel's performance was dictated by a combination of hull form, rig, the competence of the crew, the weather, sea state and currents. Individual bursts of speed were of little use on a voyage if a ship hit bad weather. For example, on 11 May 1553, Willoughby and Chancellor's small fleet of three ships left London on a voyage to discover the north-east passage. They struggled out of the Thames Estuary against adverse winds, reached a point off the north Norfolk coast by 30 May, but were then blown back to the Suffolk coast. They finally left England on 23 June, nearly six weeks after their triumphant departure from Greenwich.[51] Most merchant ship voyages of the period were probably not as frustrating as this example, but sailors and merchants all had to be prepared for such eventualities, and for some very long hauls.

Once a ship reached port, loading or unloading might be undertaken with the aid of wharfside cranes, which existed in some places, with the crew probably doing most of the work. In some cases it was possible to create a makeshift crane on the ship, using a rope and pulley attached to yardarm, or some sheerlegs rigged to the side of the hull.[52]

As has been already noted, many non-royal ships were armed, either so that they could be used for privateering or piracy, or could defend themselves against a whole range of possible assaults, from all-out attacks to nautical 'muggings'. One out-and-out pirate ship was 120-ton *Galleon Fenner*, arrested by the HCA in 1585 on suspicion of having been used 'pirateously'. This ship had a crew of about 70 and carried fifteen cannon, thirteen anti-personnel pieces and many small arms. Owned by the Fenner family, prominent Chichester gentry, the *Galleon* had sailed with a privateering licence. It was then used to capture anything its owners could lay their hands on. [53]

With all the dangers posed by man and nature, going to sea in the 16th century was a hard, dangerous life. It was small wonder that, as Sir Henry Mainwaring claimed, many sailors were very superstitious. One curious belief related to what happened when victuals were loaded into a ship at the quayside:

"if by chance in stowing the provision she heel to the starboard, [they] will say it is a sign of a long and bad voyage, for then they say she heels from landward, because they take in all their goods on the larboard side. But if she heels to larboard it is a sign of a good voyage, and some goods to come in'.[54]

Despite such uncertainties, some sailors did try to innovate. One of these was the master of the *Elizabeth* of Weymouth, which was taken by a French pirate ship in about 1581. Later explaining his actions to the High Court of Admiralty, he claimed that one of his defensive measures involved jacking up the rear wheels of a falcon on the gun deck, so that the barrel would point down, 'to make the falcon shoot the pirate ship under water'? [55]

Gresham connections

Despite all that has been written on Elizabethan seafaring in the past century and more, it is clear that we have some way to go in understanding the nature of the Elizabethan merchant ship.

To date, wreck-finds of English ships from the latter half of the 16th century are few in number. [56] The most significant English find to date is undoubtedly the so-called 'Gresham Ship', excavated in recent years by Wessex Archaeology. The remains of this vessel were found out in the Princes Channel in the Thames Estuary. It was a skeleton-built armed merchantman with frames and planks made from English oak. Dendrochronological evidence suggests that it was built soon after 1574, most probably in East Anglia. The name 'the Gresham Ship' has been applied to this vessel because one of the iron guns that it carried bore the initials and the grasshopper emblem of Sir Thomas Gresham, the great Elizabethan merchant and founder of this series of lectures.[57]

There is another connection between Gresham College and this evening's subject. Matthew Baker, Master Shipwright of Deptford dockyard died in 1613. The bequests in his will included 'the choice of my books of arts', a ship model, a portrait of himself and his two best pictures for 'my wellbeloved friend Mr John Wells'.[58] Wells was the Keeper of Naval Stores at Deptford dockyard in the early decades of the 17th century, and a keen mathematician. He used the blank pages in Baker's shipbuilding manuscript to write notes on logarithms, sundials and other matters. He was also a close friend and associate of other men of science, including Henry Briggs, Henry Gellibrand and Edmund Gunter, who all became professors of

Gresham College.[59]

Abbreviations

CSPD *Calendar of State Papers, Domestic*

ESRO East Sussex Record Office

HCA High Court of Admiralty

MM *Mariner's Mirror*

NMM National Maritime Museum, Greenwich

ODNB *Oxford Dictionary of National Biography*, online version 2004, various authors (www.oxforddnb.com)

OED *Oxford English Dictionary*, online version 2009 (www.oed.com)

TNA The National Archives, Kew

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[1] TNA HCA 24/53, f.23r.

[2] Friel 1995, 170-80; Hutchinson 1994, 44-46.

[3] Richard Hakluyt, Principal Navigations, Vol 3, Ch 8, online edition at www.ebooks.adelaide.edu.au; Manwaring and Perrin 1922, 222.

[4] Pepysian Library, Magdalen College, Cambridge MS 2820; copy consulted here is NMM PST 20 A and B.

[5] Bellabarba 1993, 274-84, 288; *ODNB* article on 'Matthew Baker' by J McDermott.

[6] NMM PST 20 A, p.25.

[7] NMM 1988, 153.

[8] CSPD Elizabeth 1591-94, Vol.243, no 110, quoted in Oppenheim 1896, 126.

[9] Oppenheim 1896, 132; for a 1609 Rye shipbuilding contract, see ESRO RYE 140/54.

[10] Story Donno 1982, 21 and 114, n 4 and 5.

[11] ESRO RYE 140/54.

[12] Friel 1995, 39-46.

[13] Dietz 1991, 11.

[14] Friel 1995, 15.

[15] Rodger 1997, 231-32; Abell 1948, 39.

[16] TNA PROB 11/107.

[17] TNA PROB 11/83; PROB 11/69; PROB 11/90.

[18] Dietz 1991, 10-11; Mayhew 1987, 152.

[19] Mayhew 1987, 139-48.

[20] Friel 1995, 43-44.

[21] Mayhew 1987, 154-56.

[22] Friel 1995, 46-47; CSPD 1547-80, 7, 21 (timber reserved for the Crown near Lewisham); CSPD 1595-97, 265, 85 (600 trees reserved for Crown use in Northamptonshire).

[23] Zins 1967, 218-44.

[24] Kerridge 1985, 123; Friel 1995, 95-97; Manwaring and Perrin 1922, 113-14.

[25] Hearnshaw 1905, 92 and Hearnshaw 1906, 251, 211.

[26] McDonnell 1978, 100-02.

[27]'Hull in the 16th and 17th centuries', *A History of the County of York East Riding: Volume 1: The City of Kingston upon Hull* (1969), pp. 90-171. URL: http://www.british-history.ac.uk/report.

[28] Friel 1995, 55-57.

[29] E.g. Carasso-Kok 1975, 33.

[30] ESRO 47/37 (2).

[31] ESRO RYE 47/37 (2).

[32] ESRO RYE 47/37 (2); part of the account is reproduced in Dell 1965, 1-3, although the total cost of the vessel is given mistakenly as £53.

[33] Friel 1995, 44.

[34] Auer and Firth 2007; the authors quote from Mainwaring on p. 223.

[35] Lavery 1988, 7.

[36] Oppenheim 1896, 172-74.

[37] Figures from Williams 1988, 220-21; Oppenheim 1896, 175, gives a total of 1,630.

[38] Dietz 1991 is the source of the data for these figures; this paper and the data it presents are of great importance for the study of Elizabethan shipping; privateering: Appleby 2009, 214.

[39] Dietz 1991, 7.

[40] HCA 24/50-57, *passim*.

[41] Appleby 2009, 154-55.

[42] HCA 24/54, f.145 (b) r and 146 r.

[43] A small Spanish type.

[44] HCA 24/53, f.126r.

[45] HCA 24/56, f.121r.

[46] Manwaring and Perrin 1922, 87, 110-11, 131-33,

[47] Marsden 2003, 97-99.

[48] Fury 2002, 192-96; Richard Hakluyt, Principal Navigations, Vol 3, Ch 2, online edition at www.ebooks.adelaide.edu.au.

[49] Fury 2002, loc. cit.

[50] Manwaring and Perrin 1922, 255-56; contrary to what Mainwaring says, the great Swedish warship *Vasa* of 1628 had a whipstaff.

[51] Friel 2003, 117 and 118.

[52] Manwaring and Perrin 1922, 223.

[53] HCA 24/53, f 60r - 62r; Appleby 2009, 190-91.

[54] Manwaring and Perrin 1922, 163.

[55] HCA 24/52, f.225 (a) - (c).

[56] I owe this information to Dr Joe Flatman.

[57] Auer and Firth 2007; the authors quote from Mainwaring on p. 223.

[58] TNA PROB 11/122.

[59] Johnson 1940, 429-32; Baynes and Pugh 1981, 69-75 and 237, n.4.