

NAVAL POWER AND MARITIME TECHNOLOGY DURING THE HUNDRED YEARS WAR

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King Edward III of England issued instructions in 1356 to fourteen sheriffs, whose authority encompassed nineteen counties, to supply arms for an expedition to the Continent. The purpose was to carry the war to France in the first phase of the Hundred Years War, a conflict whose roots included dynastic claims, the control of Gascony, and an ongoing undeclared battle at sea between French and English privateers, pirates and merchants.¹ The request was one step in what became the usual practice in preparation for an overseas expedition requiring naval forces. Men were recruited for the army, supplies and equipment purveyed for the expedition, a port was selected to stage the operation and provide a place of embarkation, ships were requisitioned or arrested, mariners were hired or impressed, the king's ships, meaning those purpose-built for war or converted for such use, were ordered to the staging port, and the whole assemblage of victuals, armaments, including horses, men and ships was coordinated to arrive for transport abroad by the assembled ships and their crews. Thousands of men flooded port towns such as Plymouth, Southampton and Sandwich where they taxed the local capacity to address their needs for food and space to work and rest and supply items they needed.²

The sheriffs, who received Edward III's command in January 1356, were ordered to produce 9900 sheaves of arrows and 5600 white bows, as opposed to painted ones.³ Horses required feed and ships had to be modified to accommodate them for transport. Stalls were constructed by the use of hurdles to separate the animals and to keep them secure aboard the ships during the passage, which could be rough. Victuals included carcasses of salted beef, mutton or pork, quarters of oats, peas and beans, quarters of wheat ground into flour before shipment, weyes of cheese and dried fish, and of course, drink. Ale was provided in generous amounts as in 1340 when thirty ships were allotted supplies for forty

¹ H. J. Hewitt, *The Black Prince's Expedition of 1355–1357* (Manchester, 1958), 30.

² The records of the English Exchequer, housed in the Public Record Office in London, provide much information concerning war preparations. For war preparations based upon these sources, see Timothy J. Runyan, 'Naval Logistics in the Late Middle Ages: The Example of the Hundred Years' War', in J. A. Lynn, ed., *Feeding Mars. Logistics in Western Warfare from the Middle Ages to the Present* (Boulder, 1993), 79–100.

³ Hewitt, *Black Prince's Expedition*, 38.

days. The 1510 men aboard were allotted 60,400 gallons of ale, one gallon per man per day.⁴

The preparations for a military campaign included the provision of a considerable store of weapons in addition to bows and arrows. Castles around the country were emptied of their arms, especially the Tower of London where the main cache of royal arms was stored. Arms were manufactured or purchased, stored and shipped from the Tower or elsewhere to the port of embarkation. Fletchers, bowyers, smiths, carpenters and other fabricators performed work. Crossbows and arbalests were in plentiful supply with winches to ratchet back the bowstrings. Crossbows were used aboard ships as well as in land battles, a subject to which we will later return.⁵

Engines for war constitute the category of weapons we know the least about based on information from the primary accounts drawn from exchequer records. Little description is given to explain the purpose and operation of engines of war. Principal among them were catapults to hurl stones, springalds, and arbalests to fire large arrows by torsion. Chemical weapons existed in the form of fire and gunpowder. This *artilleria* also included the recently introduced cannons. Ribalds (*ribaldi*), small cannon grouped together on a single mounting or carriage, are found in accounts of 1345.⁶ Their first meaningful use in battle took place at Beversholdsveld in May, 1382, when men of Ghent overpowered the forces of Bruges. The use of the lowly and small ribald, firing stones or metal balls of perhaps one inch in diameter, made a difference on that occasion. Such devices could be used at sea as anti-personnel weapons. The development of large cannon capable of 'ship killing' required not only careful placement aboard ship, but a carriage adequate to provide for aiming and recoil. That development, however, would take time.⁷

When all was prepared for the expedition, the men, their horses, military supplies and victuals were boarded for the crossing. Delays were frequent and

⁴ Public Record Office, London, Exchequer, PRO, E 101/22/25. H. J. Hewitt, *The Organization of War under Edward III, 1338–62* (Manchester, 1966), 52.

⁵ Frederic C. Lane, 'The Crossbow in the Nautical Revolution of the Middle Ages', in D. Herlihy et al., eds., *Economy, Society and Government in Medieval Italy, Essays in Memory of Robert L. Reynolds* (Kent, 1969), 161–72.

⁶ For recent works on engines of war and gunpowder weapons, see Bert Hall, *Weapons and Warfare in Renaissance Europe* (Baltimore, 1988); Kelly DeVries, *Medieval Military Technology* (Peterborough, Canada, 1992), especially parts 2 and 4. For *ribaldi* see Hewitt, *Organization of War*, 72, and Hall, *Weapons and Warfare*, 49. Most early gunpowder weapons were anti-personnel weapons used to defend against boarding by an enemy.

⁷ The use of shipboard gunpowder weapons to sink another vessel probably occurred first in 1513. Recent discussion of this subject includes: Kelly DeVries, 'The Effectiveness of Fifteenth-Century Shipboard Artillery', *The Mariner's Mirror*, 84 (November 1998), 389–99, a response to N. A. M. Rodger, 'The Dreadnought Revolution of Tudor England', *Mariner's Mirror*, 82 (1996), 269–301. See also K. DeVries, 'Catapults are Not Atomic Bombs: Towards a Redefinition of Effectiveness in Pre-Modern Military Technology', *War in History*, 4 (1997), 75–91, and R. A. Konstam, '16th Century Naval Tactics and Gunnery', *International Journal of Nautical Archaeology and Underwater Exploration*, 17 (1988), 17–23.

the consequences ranged from riotous and unruly behaviour in the port towns to food shortages leading to ravaging of the local countryside. The shortage of ships or their late arrival was a frequent problem. The Black Prince's expedition to France in 1355 was delayed because of lack of ships. Prince Edward was forced to spend more money to feed and pay his waiting army while awaiting the arrival of the seventy-three vessels requisitioned for the expedition.⁸

This experience preceded the start of most expeditions during the Hundred Years War and later. Indeed, little changed. The logistics of war began with foresters, farmers, bakers, brewers, craftsmen, labourers and the transporters who moved the goods by road, river and sea. The ship was the ultimate destination. Within its timber walls the knights, soldiers, horses, weapons and victuals were packed for the crossing. In some instances, as in the later Crusades, the transports became an amphibious operational force, releasing armed mounted knights from their decks down gangways to charge an awaiting enemy. Sometimes ships were positioned alongside defensive walls where ladders were mounted from the decks or from atop masts to allow the walls to be scaled.⁹ The ship was both transport vessel and an assault weapon. The ship provided security from the sea itself as well as from sea-borne predators. If attacked by enemy forces the ship became a fighting platform.

That pride was taken in these vessels is evident from contemporary financial accounts. Flagships of fleets received special attention in preparation for sea duty. The accounts of the clerks of the ships detail expenses for paint and elaborate pennants flown from the mast and yards. Colourful vessels flying pennants of royal or noble warriors were an impressive display that was staged to discourage challenges and to deflate opponents. The exaggerated display illustrated in manuscripts of colourful vessels flying long streamers and pennants is perhaps less fanciful than we might imagine. Orders for red and gold paint and other bright colours illumine the mundane recitation of purchase orders in the accounts of the exchequer.¹⁰ Appearances were important to medieval warriors of the knightly class. Accounts of shipboard recreation by nobles include music, dancing and stylish dress, complemented by boastful language either recorded or created by chroniclers such as Jean Froissart. Froissart also employed the

⁸ Hewitt, *Black Prince's Expedition*, 40–2.

⁹ For the amphibious assault on Damietta in the Sixth Crusade, see Jean de Joinville, *Chronicle*, in *Chronicle of the Crusades*, trans. F. Marzials. For the attack on Constantinople in the Fourth Crusade, see Geoffrey de Villehardouin, *Chronicle of the Fourth Crusade and the Conquest of Constantinople* in *Memoirs of the Crusades*, trans. F. Marzials (London, 1957), 59–62. For the nature of vessels employed see John H. Pryor, 'The Mediterranean Round Ship', in R. W. Unger, ed., *Cogs, Caravels and Galleons, The Sailing Ship 1000–1650* (London, 1994), 59–76, and 'The Transportation of Horses by Sea during the Era of the Crusades: Eighth Century to 1285 AD', *The Mariner's Mirror*, 68 (February 1982), 9–27, and (May 1982), 103–26; 'The Naval Architecture of Crusader Transport Ships and Horse Transports Revisited', *The Mariner's Mirror*, 76 (August 1990), 255–73, which continues the study in earlier issues of *Mariner's Mirror*, 70 (1984), 171–219 and 275–92.

¹⁰ The purchase of paint, banners and streamers is included in the expenses of several expeditions, e.g. PRO, E. 101/392/1.

language of chivalric combat. ‘King Edward III cried to the helmsman, “Steer at that ship straight ahead of us. I want to have a joust at it.”’¹¹

Beginning in the mid-fifteenth century medieval heraldic emblems such as banners and hereditary coats of arms were replaced with standards and ensigns bearing personal badges or *devises*.¹² Antoine de la Salle explained the significance of wearing arms in battle: ‘When the coat of arms is on the armed knight or esquire, drawn up in *bataille*, upon so noble and perilous a day, let it be known that he cannot honourably be disarmed without great reproach to his honour except for one of these three reasons: victory . . . capture . . . or death. And he who does otherwise puts his life in the prince’s mercy.’¹³ The military historian Philippe Contamine argues that the change in dress is linked to the decision by the French crown that military command no longer depended on social status or blood, that professional commanders were the equal of nobles in the military forces. The social and practical world of noble warfare began to change in the fourteenth century. A uniform insignia unrelated to social status now identified armies, for the first time since the Roman legions. Standards and ensigns provided a recognisable focus for a new disciplinary centre to combat.¹⁴

Accounts of fighting aboard ship parallel the practices ashore, although the melee was rarely as chaotic at sea as on land. Froissart rejoiced at the English victory at L’Espagnols sur Mer in 1350:

The King’s ship was stoutly built and timbered, otherwise it would have been split in two, for it and the Spanish ship, which was tall and heavy, collided with a crash like thunder and as they rebounded, the castle of the King’s ship caught the castle of the Spaniard with such force that the mast on which it was fixed broke and it was flung into the sea. The men in it were killed or drowned. The King’s ship was so shattered water began to pour in. . . .

Then the King looking at the ship with which he had jousting said, ‘Grapple my ship to that one. I want to have it.’ ‘Let that one go’, his knights answered, ‘You’ll get a better one.’ So that ship went on and another big one came up. The knights flung out hooks and chains and fastened their own ship to it. A fierce battle began between them, the English archers shooting and the Spanish defending themselves lustily. The advantage was by no means with them for, the Spanish ships being bigger and higher than theirs, they were able to shoot down at them and hurl the great iron bars which did considerable damage.

The knights in the King of England’s ship seeing that it was making so much water it was in danger of foundering, made desperate efforts to capture the ship to which they were grappled. The Spaniard was taken, and all the men

¹¹ Froissart, *Chronicle*, trans. G. Brereton (Harmondsworth, 1968), 118.

¹² Malcolm G. A. Vale, *War and Chivalry: Warfare and Aristocratic Culture in England, France and Burgundy at the End of the Middle Ages* (London, 1981), 97–8. Philippe Contamine, *Guerre, état et société à la fin du Moyen Âge: études sur les armées de rois de France, 1337–1494* (Paris, 1972), 696.

¹³ Quoted in Vale, *War and Chivalry*, 94.

¹⁴ Contamine, *Guerre*, 676; Vale, *War and Chivalry*, 147–8.

on board it thrown into the sea. Only then was the King told of the danger they were in of sinking and urged to move into the ship they had just captured. This he did. But finally the day was with the English. The Spaniards lost fourteen ships, while the rest sailed on and escaped.¹⁵

Such paeans to victory and honour are reflected, perhaps most poignantly, a century later in Jean de Bueil's *Le Jouvencel*, written about 1466:

What a joyous thing is war, for many fine deeds are seen and heard in its course, and many good lessons learnt from it. When war is fought in a good cause it is fought for justice and the defence of right. I believe that God favours those who risk their lives by their readiness to make war to bring the wicked, the oppressors, the conquerors, the proud and all who deny true equity, to justice. War is a proper and useful career for young men, for which they are respected by both God and man. You love your comrade so much in war. When you see that your quarrel is just and your word is fighting well, tears rise to your eyes. A great sweet feeling of loyalty and pity fills your heart on seeing your friend so valiantly exposing his body to execute and accomplish the command of the Creator. And then you prepare to go and live or die with him, and for love not to abandon him. And out of that there arises such a delectation, that he who has not tasted it is not fit to say what a delight it is. Do you think that a man who does that fears death? Not at all; for he feels so strengthened, he is so elated, that he does not know where he is. Truly he is afraid of nothing.¹⁶

Johan Huizinga in *The Waning of the Middle Ages* (1919) provided a social context for the era by his skilful look at literary and artistic sources of northern France and the Low Countries.¹⁷ One of these, Jean de Bueil, author of *Le Jouvencel* and a veteran of the Hundred Years War, provided important though often anachronistic advice on the conduct of the warrior in an age now termed one of military revolution.¹⁸ The march toward modern professional armies is interrupted by the life of the tournament and joust, activities that thrived in an age struggling to accommodate the new military technology, while chivalric codes may have become more flexible. This did not mean the practice of chivalry was less dangerous: recall the death of Henry II of France in a joust in 1559,

¹⁵ Froissart, *Chronicle*, 118–19.

¹⁶ Jean de Bueil, *Le Jouvencel*, translated by Vale in *War and Chivalry*, 30.

¹⁷ Johan Huizinga, *The Waning of the Middle Ages*, trans. F. Hopman (Harmondsworth, 1965; orig. pub. 1919).

¹⁸ For a summary analysis see Clifford J. Rogers, ed., *The Military Revolution Debate: Readings on the Transformation of Early Modern Europe* (Boulder, 1995). This interpretation originated with Michael Roberts's lecture printed in 1956, 'The Military Revolution, 1550–1650', reprinted in his *Essays in Swedish History* (Minneapolis, 1967), and Rogers, *Military Revolution Debate*, 13–36. Although C. W. C. Oman in *The Art of War in the Middle Ages*, rev. and ed. J. H. Beeler (Ithaca, 1953), 162, referred to 'the military revolution of the sixteenth century' during the European wars against the Ottomans. Rogers, *Military Revolution Debate*, 79 n. 2. The debate accelerated following publication of Geoffrey Parker's *The Military Revolution: Military Innovation and the Rise of the West* (Cambridge, 1988).

or Pierre de Bueil who died jousting at the court of Charles VII in 1445, or the triage necessary to save Philippe de Poitiers, Lord of La Ferte, whose arm was torn off in a joust during Anglo-Burgundian marriage celebrations at Bruges in 1468.

The development of gunpowder weaponry continued with the support of states capable of funding the range of materials and talent necessary to advance these machines of war, silently condemned by those participating in the chivalric tournament. Neither condemnations nor prescriptions would alter the drive for advantage in weapons technology. In the late twelfth century the Byzantine Anna Comnena in her *Alexiad* condemned the crossbow as truly a diabolical machine. The papacy agreed and at the Second Lateran Council of 1191 anathematised all who used the crossbow, and the bow. The council did see some advantages to the devilish instruments of war, however, and perhaps with some delight denied use only between warring Christians, who could use them with impunity against infidels. The Venetian Commune ordered 20,000 crossbow bolts in 1304. A decade later an inventory of the Arsenal recorded 1131 crossbows.¹⁹ Ships carried them in abundance, as noted.

Tournaments and battles on land and sea had one quality in common: the sound of the drum. The evidence from underwater archaeology is scant, but drums and other instruments are among the artefacts found in Henry VIII's *Mary Rose*, lost off Portsmouth while engaging a French invasion fleet in 1545. Froissart describes the music aboard the ships of Edward III and his son the Black Prince, including the drum. The tabor (*tabour* or *tabourin*) was usually accompanied by the pipe (also found on the *Mary Rose*). Trumpets were used for both music and announcements. In anticipation of battle or the later celebration of victory, music aboard ship was employed to entertain and refresh. Dancing accompanied playing before the sea battle at L'Espagnols sur Mer in 1350. As late as the sixteenth century little had changed. Musicians included trumpeters and those playing drum, fife and shawm. The trumpeter sounded the going and coming of the commander, hailed ships, and sounded the charge to board an enemy vessel.²⁰

For England the sources for examining a case study of the logistical work that preceded the launching of a fleet to transport an army abroad are found in numerous places. The key sources include financial accounts from the Exchequer and the Wardrobe account books. Fortunately, a Wardrobe account book has been edited for the early years of Edward III's reign, 1338–40.²¹ As his

¹⁹ P. Contamine, *War in the Middle Ages*, trans. M. Jones (Oxford, 1984), 72.

²⁰ For the *Mary Rose* artefacts see Margaret Rule, *The Mary Rose* (London, 1982), 199. Jean Froissart describes the musical accompaniment aboard Edward III's ship. Jean Froissart, *Chronicles of England, France, Spain and the Adjoining Countries from the latter part of the Reign of Edward II to the Coronation of Henry V*, trans. Thomas Johnes (London: George Routledge, 1868), I, 197–9.

²¹ Bryce and Mary Lyon, eds, *The Wardrobe Book of William de Norwell, 12 July 1338 to 27 May 1340* (Brussels, 1983). There is also an edition of a book from the reign of Edward I,

personal financial account, the king could and did finance many of his campaigns from the Wardrobe. The personnel costs of soldiers and sailors, the numbers and types of vessels with their masters and homeports, the horses carried, are all recorded in the account book.

Edward prepared a campaign to the Low Countries in 1338 that was to last for over two years. It cost £382,000. Over 291 ships were utilised to transport his forces to Antwerp. Another 80 ships assisted in the operation. Manning the fleet required 12,263 masters, constables, sailors, pages and carpenters who were paid wages of £4797 11s. 6d. The fleet carried 2720 earls, bannerettes, knights, squires, men-at-arms and hobelars, 5550 mounted and unmounted archers, 4614 horses, and the 500 members of the king's and queen's household.²² This was the largest logistical effort made for an overseas military campaign by an English king up to the time. The preparations were predictably delayed because of the difficulty in assembling the ships, men and supplies. Once they were in place at Orwell and Great Yarmouth the crossing of the North Sea took place from 16 to 22 July 1338. The 370 ships required 370 masters, but only 282 constables to govern the men as smaller vessels did not have constables, 11,325 sailors, 585 pages, 5 clerks and 4 carpenters. The ports providing most of the ships were Great Yarmouth (61) and Melcombe in Dorset (52). Hythe, Rye, Ipswich, Ravenscar and Plymouth provided another 179 ships. An interesting note is that 17 ships were arrested for service while in Brabant and Flanders. The men received higher pay. Perhaps ships arrested abroad commanded higher fees.²³

One item of particular interest in the Wardrobe account book is the payment of £97 for 291 pilots to guide the ships from Orwell to Antwerp. Each pilot received one half mark (6s. 8d.) as wages. Pilots were also employed for return voyages. Their wages were good. Mariners earned only 3d. per day.²⁴

Information is sketchy on the ships used in the expedition. The ship's type is not always given. The major vessel used was the cog, as fifty-two are noted. The balance included hulks, spinaces, busses and barges. Galleys were used by the king, but were not well suited for bulk transport of men, horses or *matériel*. Italians or other foreigners manned and operated galleys in most instances in both England and France. Ships and supplies came from at least sixty-four ports to carry the men and supplies about 220 kilometres (135 miles) across the North Sea to Antwerp.²⁵ But the nerve centre for naval and military operations was the Wardrobe, which served as the war treasury. The variety of sturdy vessels

Liber Quotidianus Contrarotulatoris Garderobe Anno Regni Regis Edwardi Primi Vicesimo Octavo, A.D. 1299 and 1300, ed. John Topham (London, 1787).

²² Bryce Lyon, 'The Infrastructure and Purpose of an English Medieval Fleet in the First Phase of the Hundred Years' War (1338–1340)', *Maatschappij voor geschiedenis en oudheidkunde te Gent*, new series 51 (1997), 61–76.

²³ Lyon, 'Infrastructure', 67.

²⁴ *Ibid.*, 74.

²⁵ *Ibid.*, 67. For the cogs of this era see chapters 2 and 3 by Detlev Ellmers, 'The Cog as Cargo Carrier', and T. J. Runyan, 'The Cog as Warship', in Unger, *Cogs, Caravels and Galleons*. For the preponderance of cogs, see T. J. Runyan, 'Ships and Fleets in Anglo-French

manned by mariners transported the men, horses, supplies and victuals to their overseas destinations. The wardrobe accounts and other exchequer records detail the expenses of building, outfitting, repairing and provisioning ships for service. Busses, flunes, gabots, hulks, doggers, lodships, crayers, spinaces, galleys, carracks, barges, nefes, tarites, boats, ships and cogs are named in the records of English vessels active in the early phase of the Hundred Years War from 1337 to 1360.²⁶ Some were small sailing craft, others oared vessels and others large sailing ships capable of carrying several hundred tons of cargo, where each ton equates to the wine ton with a capacity of 264 gallons. Galleys, balingers and other oared vessels were useful in war because of their ability to manoeuvre in calms or against currents, tides, or the direction of the wind. Vessels dependent solely on the wind for propulsion had to tack to make headway against the wind. While two-masted vessels had long plied the Mediterranean, the appearance of two and three-masted ships in the northern seas did not occur until the early fifteenth century.

What changes made possible the creation of sailing ships and fleets that within a century dominated the seas of Western Europe while reaching south along the African coast and Indian Ocean and west to the New World?²⁷ Ship construction and design underwent substantial changes in the period from about 1300 to 1500. Part of that change may be explained as the continuous search for efficiency of sea-borne transport under sail. Another explanation is the merger of two distinct maritime traditions, that of the Mediterranean and that of the northern seas.²⁸ Florentine chronicler Giovanni Villani reported in the summer of 1304 that sailors from Bayonne on the Bay of Biscay sailed cogs into the Mediterranean. Their successful raids impressed the Genoese, Venetians and Catalans who began to build cogs. In fact, *coches* or cogs were known in the Mediterranean before that date. The literary and iconographic evidence is sketchy until the mid-fourteenth century when artists produced illustrations of *coches* in harbour and at sea.

Warfare, 1337–60', *The American Neptune*, 46 (1986), 91–9, and 'The Organization of Royal Fleets in Medieval England', in *Ships, Seafaring and Society: Essays in Maritime History* (Detroit, 1987), 37–52.

²⁶ Runyan, 'Ships and Fleets', 91–9.

²⁷ On ships of this era see Unger, *Cogs, Caravels and Galleons*, Ian Friel, *The Good Ship: Ships, Shipbuilding and Technology in England, 1200–1520* (London, 1995), R. W. Unger, *The Ship in the Medieval Economy* (London, 1980), and A. R. Lewis and T. J. Runyan, *European Naval and Maritime History, 300–1500* (Bloomington, 1985). For a study based on archaeological remains of ships, see Gillian Hutchinson, *Medieval Ships and Shipping* (Leicester, 1994).

²⁸ One approach to this subject is T. J. Runyan, 'The Relationship of Northern and Southern Seafaring Traditions in Late Medieval Europe', in C. Villain-Gandossi, S. Busuttil and P. Adam, eds, *Medieval Ships and the Birth of Technological Societies: The Mediterranean Area and European Integration* (Malta, 1991), 197–209. For ship construction, see J. Richard Steffy, 'The Mediterranean Shell to Skeleton Transition: A Northwest European Parallel', in Reinder Reinders and Kees Paul, eds, *Caravel Construction Technique: Fifth International Symposium on Boat and Ship Archaeology* (Oxford, 1991), 1–9.

Why did the Mediterranean shipwrights adopt the architectural form of the cog?²⁹ The answer is rooted in the pragmatism of ship construction and seafaring, coupled with the cost effectiveness of ships needed for trade and commerce in the age some describe as the commercial revolution.³⁰ While this commercial revolution ended about 1348 with the Black Death, the nautical revolution was just under way.³¹ The cog was a key element in the impulse for Mediterranean shipwrights to build a new type of vessel, as Villani noted. Clinker-building, perhaps most dramatically illustrated in the Viking ships of the eighth to tenth centuries, marked northern European shipbuilding. The ship-building method practised in the northern seas was to fashion the hull from the keel up by overlapping the planking and fastening the planks or strakes with clinch-bolts, thus clinker construction. Frames were then inserted inside the hull. Shell-first construction required skilled craftsmen capable of fashioning the lines of vessels over twenty-five metres in length into marvellously fluid shapes that could withstand the cold and rough waters of northern Europe while providing enough durability and integrity to survive lengthy voyages to Greenland, Iceland, the Hebrides, Ireland, across the Baltic, the inland waterways of eastern Europe, and to the Mediterranean. Controlled by a side steering-oar, or quarter rudder, and driven by a square sail supported from a yard on a single mast, the vessel was clearly effective as a carrier of persons and a limited amount of cargo. The successor vessel that stands out among the many types

²⁹ Ships built frame-first include the Sefe Limani vessel of c.1025 and the Contarina ship of c.1300. George Bass, Sheila Matthews, J. Richard Steffy and Frederick H. Von Doorninck, eds, *Serçe Limani: An Eleventh-Century Shipwreck* (College Station: Texas A&M University Press, forthcoming). For the round ship and its replacement by the cog see John H. Pryor, 'The Mediterranean Round Ship', in Unger, *Cogs, Caravels and Galleons*, ch. 4; Hutchinson, *Medieval Ships*, 35–46.

³⁰ Raymond de Roover, 'The Commercial Revolution of the Thirteenth Century', *Bulletin of the Business Historical Society*, 16 (1942), 34–9, and the *Cambridge Economic History of Europe*, vol. III (Cambridge, 1963). Robert S. Lopez, *The Commercial Revolution of the Middle Ages, 950–1350* (Englewood Cliffs, 1971), 72: 'The Commercial Revolution of Italy and the western Mediterranean put to work every kind of ship, from the tiny rowboats to broad, roomy sailing 'nefs', but tied its fortune especially to the galley and its many relatives.' Frederic C. Lane, 'Venetian Shipping during the Commercial Revolution', *American Historical Review*, 38 (1933), 219–39, focuses on the fifteenth and sixteenth centuries.

³¹ Frederic C. Lane identified the nautical revolution as innovations in navigation and shipping about 1300. 'While the Venetian aristocracy was consolidating its position domestically, reaffirming Venice's lordship of the gulf, and recovering from the defeat received in the Second Genoese War, it had to adjust its maritime and commercial institutions to profound changes in both the nautical arts and in business methods. If one may apply the term revolution to changes which went on over a period of a hundred years, one may properly call the changes about 1300 in the methods of navigation and in the construction, rigging and armament of ships the Nautical Revolution of the Middle Ages. It was a necessary preliminary to the more celebrated nautical revolution of the Renaissance which accompanied the oceanic discoveries about two hundred years later.' F. C. Lane, *Venice: A Maritime Republic* (Baltimore, 1973), 119. For a discussion of his views, see Michael Balard, 'La Révolution nautique à Gênes (fin du XIIIe – début au XIVe s.)', in Villain-Gandossi *et al.*, *Medieval Ships*, 113–23.

already noted is the cog. While its roots extend to the Carolingian era the cog arrived as a ship of major significance at the start of the fourteenth century.³²

The fruits of underwater archaeology have provided much information about this vessel type since 1962 when a nearly complete cog was found at the harbour in Bremen. Dating to about 1380 with a capacity of about 78–80 tons, the vessel, though impressive, is not a large cog. As early as 1241, a cog is recorded with a capacity of 240 tons. These larger vessels became the mainstay of shipping in northern Europe.³³ They also were among the first to employ the significant advantage in navigation provided by the sternpost-mounted rudder affixed by pintles and gudgeons. The sternpost-mounted pintle-and-gudgeon rudder was in use in Western Europe by the late twelfth century. The most frequently cited evidence is the carved baptismal font at Winchester Cathedral dating to 1150–80. The seal of Ipswich of about 1200 also depicts a sternpost rudder. We can assume that this new rudder was in use for some decades since it is unlikely artists working in such varied media and locations immediately recorded its appearance on ships.³⁴ The adoption of the sternpost rudder in the northern seas was not a straight-line evolution of an improved technology. Dual quarter rudders were employed on large Roman vessels and later Mediterranean galleys, crusader ships and even those vessels that faced one another at Lepanto in 1571. They were efficient and seaworthy quarter rudders. The advantages of a sternpost rudder included convenient placement so that a tiller could control its movement, its protection from weather and attack, as well as when docking on the starboard or steering board side, and with pintle-and-gudgeon mounting, reliability. A disadvantage was that it was more difficult to replace or repair.³⁵

A paradox in the history of the adoption of the sternpost rudder is that examples of it are found in Egyptian funerary boats and it was in use three millennia later by the Arabs in the Red Sea and Persian Gulf. Iconographic evidence from Arab manuscripts from the early twelfth century includes a sternpost rudder, in this instance assisted by two quarter rudders. If this is an advanced technology, then why was it not adopted throughout the Mediterranean? The answer is that there were no iron fasteners on these Arab vessels. The rudder was lashed to the stern of the vessel providing a weak connecting point. The use of iron pintles and gudgeons made the difference. Also, the Arabs used controlling lines to turn

³² For ship construction techniques, see J. Richard Steffy, *Wooden Ship Building and the Interpretation of Shipwrecks* (College Station, 1994), especially part II; Unger, *Cogs, Caravels and Galleys*, 29–58.

³³ Klaus-Peter Kiedel and Uwe Schnall, eds., *The Hanse Cog of 1380* (Bremerhaven, 1985); Detlev Ellmers, 'The Cog as Cargo Ship', *Cogs, Caravels and Galleys*, 29–46; Paul Heinsius, *Das Schiff der Hansischen Frühzeit* (Weimar, 1956) which identified the cog as a new type vessel of the twelfth century, a view not shared by Ole Crumlin-Pedersen, 'Danish Cog Finds', in Sean McGrail, ed., *Medieval Ships and Harbours in Northern Europe* (Oxford, 1979), 17–34.

³⁴ Lawrence V. Mott, *The Development of the Rudder: A Technological Tale* (College Station, 1997), 123.

³⁵ *Ibid.*, 41–99.

the rudder. These lines were attached directly to the rudder so that by pulling on the port or starboard line the rudder would turn. This was not effective on larger vessels. The tiller is not found on larger Arab ships until introduced by the Portuguese in the fifteenth century.³⁶ The reintroduction to the Mediterranean of the sternpost rudder by northern mariners probably occurred in the mid-twelfth century, perhaps with the fleets carrying soldiers for the Second Crusade in 1147. The cog is closely associated with the sternpost rudder, which became one of its identifying characteristics. It appears the Catalan king Jaime I used cogs as part of his fleet to attack Mallorca in 1229. Cogs appear in graffiti on the bell tower of the cathedral of Palma de Mallorca, and the term *coca* appears in the Laws of Marseille of 1253.³⁷ We might predict that the rapid adoption of the pintle-and-gudgeon rudder in the early fourteenth century enabled the construction of larger and more seaworthy ships leading to the age of exploration and world trading empires, and that quarter rudders were doomed at the appearance of the new navigational technology. This was not so. Quarter rudders worked well and were used on ships of 400–500 tons as early as the fifth century BC on Roman grain ships, and large Mediterranean galleys and sailing ships used them successfully. Ships of the age of exploration were smaller and would not have required a pintle-and-gudgeon rudder as a precondition to Atlantic oceanic navigation. Columbus' ships were small though with more freeboard than galleys. The *Santa Maria* was rated at about 120 tons and galleons of the seventeenth century often were in the 300–600 ton range.³⁸

War is cited as a major cause for change. Change may include the alteration of social structures, the realignment of political borders, the innovation of technologies and the creation of new institutions. Should it also be the catalyst for the rise of standing navies? The Hundred Years War of 1337–1453 largely dominated the fourteenth and fifteenth centuries in Western Europe. During this period, the English crown needed naval forces in order to address attacks from the sea, to protect shipping and to transport invading armies overseas. Ships were also necessary for victualling, blockades and to transport armies and goods back home. The French and their allies had similar uses for naval forces.

Privately owned shipping supplied the bulk of ships for royal expeditions through the process of obligation and arrest. The establishment of a more permanent fleet of king's ships with an administrative agent to supervise their care and maintenance emerged during this era. The office of admiral and clerk of king's ships in England was mirrored in France, though unevenly. The office of admiral was created and briefly there was a centralised navy with the *Clos*

³⁶ R. Bowen, 'Early Arab Ships and Rudders', *Mariner's Mirror*, 49 (1963), 303–4, and Mott, *Rudder*, 124–5.

³⁷ Mott, *Rudder*, 121–6.

³⁸ *Ibid.*, 127. See also Ian Friel, 'The Carrack: The Advent of the Full Rigged Ship', in Unger, *Cogs, Caravels and Galleons*, 77–90; Martin Elbl and Carla Rahn Phillips, 'The Caravel and the Galleon', in Unger, *Cogs, Caravels and Galleons*, ch. 6; for tonnages, see 114.

des Galées established in 1293 at Rouen.³⁹ The Court of Admiralty developed in England in the fourteenth century, capable of adjudicating cases *in rem* to the dismay of the common-law courts.⁴⁰ The emergence of standing navies composed of purpose-built ships of war, carrying gunpowder weapons and capable of keeping the sea under the command of professional sailors occurred in the fourteenth century. The royal fleets did not always function well. The ships were sometimes more purpose-modified than purpose-built. There were gunpowder weapons aboard ship but they were not ship-killers. They were anti-personnel weapons. Sea-keeping was limited by the nature of the vessels and navigational knowledge, and mariners on the royal payroll under crown-appointed officers were effective for the length of individual expeditions, but did not constitute a standing navy.

Unlike admirals in the Mediterranean states and France, English admirals primarily served as administrators. Their responsibility was to arrest ships and men, get them to the chosen ports for assembly into fleets, and prepare them for the expedition. It was a big job. Once at sea, the admiral was active in directing the fleet, but often shared that responsibility. His flagship carried lanterns and flags, or streamers, to signal commands to the fleet. Nearly half of the admirals who served during the fifty-year reign of Edward III had served in the field as well as at sea.⁴¹ Admirals outranked captains, masters, constables (responsible for marines), carpenters, clerks, and seamen. The admiralties were generally divided into a northern (Thames to Scotland), a southern (Thames to Bristol) and a western fleet (from Bristol to Carlisle including Ireland). The vice-admirals usually assumed duties for districts to which they were assigned, including coastal defence.⁴²

Naval experience was doubtless applied to the development of strategy. Medieval knights at sea or ashore devised strategies and tactics. The French, who recruited Genoese naval commanders to prepare fleets to attack England, displayed strategic thinking as French diplomats also encouraged the Scots to raid northern England – a serious assault as well as a feint to divert English military resources from the Channel.⁴³

³⁹ Anne Chazelas-Merlin, ed., *Documents relatifs au clos des galées de Rouen et aux armées de mer du roi de France de 1293 à 1418*, 2 vols (Paris, 1977–9), and for the carvel-built galley, Eric Rieth, 'Les Clos des galées de Rouen, lieu de construction navale à clin et à carvel (1293–1419)', in C. Villain-Gandossi, S. Busuttil and P. Adam, *Medieval Ships and the Birth of Technological Societies, Volume I: Northern Europe* (Malta, 1989).

⁴⁰ T. J. Runyan, 'The Laws of Oléron and the Admiralty Court in Fourteenth Century England', *American Journal of Legal History*, 19 (April 1975), 95–111; R. G. Marsden, ed., *Documents Relating to the Law and Custom of the Sea, I, 1205–1648* (London, 1915) and *Select Pleas in the Court of Admiralty* (London, 1894).

⁴¹ N. A. M. Rodger, *The Safeguard of the Sea* (New York, 1997), 131–6.

⁴² R. G. Marsden, 'The Vice-Admirals of the Coast', *English Historical Review*, 22 (1907), 468–77, and 23 (1908), 736–57.

⁴³ W. Stanford Reid, 'Sea-Power in the Anglo-Scottish War, 1296–1328', *Mariner's Mirror*, 46 (1960), 7–23; R. G. Nicholson, *Edward III and the Scots: The Formative Years of a Mili-*

Conflict at sea began with piratical raids on each side of the Channel, mainly directed at merchant vessels or port towns. Raids on port towns were often launched to avenge similar attacks across the Channel. As an element of maritime strategy raids on port towns made sense because the ships were there. The destruction or capture of enemy vessels was the objective rather than to hold territory. The spread of terror was a consequence of sea-borne raids on ports. Among the most terrifying were the Franco-Genoese raids along the south coast in 1338–40. Southampton was burned and raids continued from Plymouth to Harwich. Coastal defence schemes included the use of fire beacons to warn of attacking ships, but they were not very effective.⁴⁴ A pre-emptive strike was the best defence. The English attack on the French and Spanish at Sluis in 1340 was a masterful strike that caught the enemy fleet embayed and unable to manoeuvre. The English came sailing in unexpectedly and as Geoffrey le Baker states, Edward III had ‘the wind and the sun at his back and the flow of the tide with him, with his ships divided into three columns, . . . an iron shower of quarrels from crossbows and arrows from longbows brought death to thousands of people’. The French lost nearly 200 ships.⁴⁵

There are few parallels to the English naval victory at Sluis, although many naval engagements were fought in harbours, bays or along shore trading routes. Examples include the English victory over the Spaniards off Winchelsea in 1350 and their defeat by Castilian galleys in the battle at La Rochelle in 1372. The most effective vessel for raiding and attack was the galley. It incorporated the principal requirements of speed and manoeuvrability.⁴⁶

The French had a considerable ally in Scotland, a base for naval raids that distracted the English from their designs in France. English naval effort was directed toward the invasion fleets necessary to transport and supply English armies on the Continent. The continued arrest of shipping for this purpose does not suggest that a grand naval strategy for ‘sovereignty of the sea’ was in play. The English countered at sea, but perhaps most effectively in diplomacy by hiring away Genoese ships and naval commanders. The response to raids on

tary Career 1327–1375 (London, 1965). See also C. J. Ford, ‘Piracy or Policy: The Crisis in the Channel, 1400–1403’, *Transactions of the Royal Historical Society*, 5th ser., 29 (1979), 63–78.

⁴⁴ Colin Platt, *Medieval Southampton: The Port and Trading Community, AD 1000–1600* (London, 1973), 109 ff. Michael Hughes, ‘The Fourteenth-Century French Raids on Hampshire and the Isle of Wight’, in Anne Curry and Michael Hughes, eds, *Arms, Armies and Fortifications in the Hundred Years War* (Woodbridge, 1994), 121–43.

⁴⁵ Geoffrey le Baker, *Chronicon*, ed. E. M. Thompson (Oxford, 1899), 68–9.

⁴⁶ James Sherborne, ‘The Battle of La Rochelle and the War at Sea, 1372–5’, *Bulletin of the Institute of Historical Research*, 42 (1969), 17–29, and ‘English Barges and Ballingers of the Late Fourteenth Century’, *Mariner’s Mirror*, 63 (1977), 109–14. Mario Bandioli, Rene Burlet, Andres Zysberg, ‘The Naval Architecture and Oar Systems of Medieval and Later Galleys’, in Robert Gardiner, ed., *The Age of the Galley: Mediterranean and Oared Vessels since Pre-Classical Times* (London, 1995), 172–205; Ulrich Alertz, ‘The Naval Architecture and Oar Systems of Medieval and Later Galleys’, *ibid.*, 142–62.

commercial shipping, especially the English wine trade to Gascony, was the use of convoys. Numerous reports attest to the raids on merchant shipping. Convoys afforded some protection for merchants, but they also presented larger targets for enemies. Intelligence was a key factor for all parties in naval warfare. Obviously it would be difficult to disguise the preparations necessary to organise a convoy. Spies were common to all ports. The threat to English shipping was so great that convoys were mandated at various times. The customary escorts for merchant convoys consisted of large armed merchantmen and sometimes the king's ships. This would change with the use of gunpowder weapons aboard ships purpose-built to accommodate them.⁴⁷

The French, their allies and paid *condottieri* used a mixture of strategies to continue the war at sea in an effort to disrupt the English invaders. They were never able to successfully reverse the tide and carry the war to England on more than a limited basis. Vessels did patrol the Channel and North Sea, but on no set schedule and they were unable to stay on station. Blockades were attempted infrequently. But in early-fifteenth-century England ships did cruise in search of the enemy on sea-keeping missions. Henry V understood the value of the navy that he used in his successful invasion of Normandy. The French lost many of their Channel ports and much of their fleet as a consequence. This lesson was lost on his successors who sold off the fleet, opening an era of piracy and losses abroad.⁴⁸

Elements of a maritime strategy can be seen in the literature of the Hundred Years War, perhaps nowhere more pointedly than in the *Libelle of Englyshe Polycye*, written in the 1430s. The anonymous author proposed blockading the passage to Dover while securing Calais and interdicting Flemish trade:

Cherishe merchandise, keep the Admiralty,
That we be masters of the Narrow Sea.⁴⁹

These proposals were never implemented, a reminder that maritime strategy remains a subset of a national grand strategy.⁵⁰ Another century would pass before all the elements of a standing navy began to come together. Naval historians since Mahan have debated his interpretation of the influence of sea power upon history. Indeed, an attempt was made in 1997 to examine Mahan's

⁴⁷ *The Calendar of Patent Rolls* includes many references to convoys: see CPR (1340–3), 567–70, CPR (1350–4), 486; H. J. Hewitt, *The Organization of War under Edward III, 1338–1362* (Manchester, 1966), 23, 67, 77; Timothy J. Runyan, 'Wine and War: The Anglo-Gascon Wine Trade in the Later Middle Ages', in Klaus Friedland, ed., *Maritime Food Transport* (Vienna, 1994), 245–55.

⁴⁸ C. F. Richmond, 'The Keeping of the Seas During the Hundred Years War: 1422–1440', *History*, 49 (1964), 283–98; and his 'English Naval Power in the Fifteenth Century', *History*, 52 (1967), 1–15.

⁴⁹ *The Libelle of Englyshe Polycye, A Poem on the Use of Seapower*, 1436, ed. G. W. Warner (Oxford, 1926). See G. A. Holmes, 'The Libel of English Policy', *English Historical Review*, 76 (April 1961), 193–216.

⁵⁰ John B. Hattendorf, *Naval History and Maritime Strategy: Collected Essays* (Malabar, Florida, 2000), 256.

influence on medieval maritime history at a meeting in New York of the American Historical Association.⁵¹ As more effort has been directed to the study of late medieval history, its link to the subsequent era of the Renaissance/early modern period grows stronger and the distinction blurs. Over the past several decades arguments for a military revolution in late medieval and early modern Europe have faced substantial challenges, as noted above. Perhaps the efforts to ascertain the establishment of state navies with ships, navigational capabilities, armaments and professional crews will experience similar sea changes and challenges. At last reporting, the arguments on the military revolution debate identified several paradigms. There is revolution – a dramatic change, sometimes over a long period of time. There may be multiple revolutions within the framework of the larger revolution, such as an artillery revolution or an infantry revolution. There is also a paradigm derived from the work of scientists labelled ‘punctuated equilibria’. The proposal suggests that evolutionary change occurs during rapid bursts of development after long periods of stasis.⁵² Each interpretation has its proponents and antagonists. No attempt will be made here to massage, or muscle, the maritime history of Europe into one of these models. But the challenge from this perspective seems to be answered best by the continued investigation of underwater cultural resources, which constitute our best source of new information, coupled with continued careful examination of documentary evidence.

⁵¹ Maryanne Kowaleski chaired the session, with papers by Timothy J. Runyan, Richard Unger, Fred Hocker and comment by John Hattendorf.

⁵² See C. J. Rogers, ‘Military Revolutions of the Hundred Years War’, in Rogers, ed., *Military Revolution Debate*, 76–7.

