

of the 16th century – or possibly adapted from a Chinese pump that dated from at least a thousand years earlier. The new dredger used an endless chain of paddles, like a waterwheel stretched round two axles. They were certainly already being used in Holland while the huge rake was still combing out the bed of the Lez, and were the ancestors of all modern dredgers. But the paddles still only disturbed the sediment, and left it to the stream to remove it. Where the current was not strong enough, some other method had to be tried. One way was to use buckets instead of paddles, carrying the silt up into the hold of the dredger. Another was to use scissoring grabs, similar to those now used in most earth-moving and excavating machinery, and first tried out in the lagoon of Venice.

Warship/Len Deighton

It was at sea that the invention of the cannon eventually wrought its most radical changes in the techniques of war. It was impossible to make wooden ships invulnerable to gunfire, and sailors could not escape by digging into safe earth. Henry VIII understood the importance of both cannon and sailing ships and it was with money taken from the Church that in the early 16th century he financed his new navy. Until then naval battles were fought by modified merchant ships and had mostly been a matter of grappling alongside and fighting hand to hand. Improved cannon enabled ships to stand off from the enemy and sink him by gunfire.

Speed and seamanship became the deciding factors in naval war. The old notion of a floating fort was abandoned. No longer did ships need the absurd tall castles from which soldiers could shoot their arrows, although the word 'fore-castle' still remains. Indeed,

soldiers were no longer carried.

At first naval architects tried to fit the heavy cannon into the castles, but these were flimsy structures and the weight of the guns there made the ships unstable. It was probably a shipwright named Baker who thought of placing the guns as near the waterline as possible. Such daring design sometimes proved foolhardy and in 1545 the *Mary Rose* – a fine example of the new kind of warship – sank in a light squall when her gun ports took water. Low gun ports needed carvel construction for strength, so clinker-built ships began to go out of favour.

The crude 'one-sail, one-mast' design had all but disappeared half a century before the *Mary Rose* was built, but there were still new developments in sail-making. New fabrics, smaller sails and additional masts made sailing a more subtle craft and men discovered how to sail close to the wind. Sailors learned to cope with bad weather and great oceans, and used charts and instruments to navigate through them. It was the warship that was most suitable for the voyages of discovery that marked this age, for the object of exploration was conquest.

From this time onwards the broadside was to dominate naval tactics. Admirals led their fleets into battle sailing in line instead of disorganised clusters. Such ships of the line were to undergo only slight changes right until the coming of steam, and guns changed even less. Those of the *Mary Rose* were salvaged from the sea bed and were found to be almost identical to the guns used at Trafalgar.

Right, above: drawing by Roland Savery of a dredger. Such machines seem first to have been used in the Low Countries. Right: the famous warship Mary Rose, carrying her cannon daringly near the water-line