the 18th century it was constantly found that the dimensions of French ships exceeded those of British ships of the same date, and that French vessels were superior in speed. This led from time to time to an increase of the measurements of the various classes of vessels in the British navy. These were now rated according to the number of guns which they were constructed to carry.

A 90-gun ship of the line at the beginning of the 18th century averaged 164 ft. in length of gun deck, 47 ft. beam, and about 1570 tons, while the frigates now ran to 120 ft. with 34 ft. beam and from 600 to 700 tons. These dimensions, however, were not always maintained, and towards the middle of the century the Admiralty seem to have recognized the consequent inferiority of their ships. The famous and ill-fated “ Royal George,” launched in 1756, was the result of an effort to improve the line- of-battle ship of the period. She was 178 ft. in length, 52 ft. in beam, was of over 2000 tons, and carried 100 guns and a crew of 750 men. The “ Victory,” Nelson’s flagship, was built nearly ten years later. Her dimensions were 186 ft., 52 ft., 2162 tons, and she carried 100 guns. During the same period frigates, which were cruisers carrying their armament on one deck, were built to carry 32 or 36 guns, but in this class also the French cruisers were superior in speed and of larger dimensions. The remainder of the 18th century and the beginning of the 19th witnessed a continuous rivalry in naval architecture, the French and Spanish models being constantly ahead of the British in dimensions and armament. In the American war (1812) the same disparity as regards dimensions became apparent, and the English frigates, and sloops used as cruisers, were generally outclassed, and in some instances captured, by American vessels of their own rate. This as usual led to the construction of larger vessels with greater speed, and though, after the con­clusion of the long war, the activity of the royal dockyards slackened, yet the great three-deckers of the last period, before the adoption of steam power, had reached a length of over 200 ft., with more than 55 ft. beam, and over 3000 tons.

Meanwhile the mercantile navies of the world, but more especially of England, had largely increased. The East India- man, as the armed vessels of the East India Company were called, really performed the functions of merchant vessel, passenger ship, and man-of-war. But, where there was no monopoly, competition soon quickened the development of trading vessels. The Americans with their fast-sailing “ clippers ” again taught the English builders a lesson, showing that increased length in proportion to beam gave greater speed, while admitting of lighter rigging in proportion to tonnage, and of economy as regards the number of men required to work the ship. The English shipyards were for a long time unequal to the task of producing vessels capable of competing with those of their American rivals, and their trade suffered accordingly. But after the repeal of the Navigation Laws in 1850 things improved, and we find clippers from Aberdeen and from the Clyde beginning to hold their own on the long voyages to China and elsewhere.

At this epoch steam power appears in use on the scene, and the period of great wooden vessels closes with iron and steel taking their place in the construction of the hulls, while the sail gives way to the paddle and the screw.

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II. History since the Introduction of Steamships

Before steam was applied to the propulsion of ships, the voyage from Great Britain to America lasted for some weeks; at the beginning of the 20th century the time had been reduced to about Six days, and in 1910 the fastest vessels could do it in four and a half days. Similarly, the voyage to Australia, which took about thirteen weeks, had been reduced to thirty days or less. The fastest of the sailing tea-clippers required about three months to bring the early teas from China to Great Britain; in 1910 they were brought to London by the ordinary P. & O. service in five weeks. Atlantic liners now run between England and America which maintain speeds of 25 and 26 knots over the whole course, as compared with about 12 knots before the introduction of steam. The accommodation in the modern passenger ships is palatial compared with that in the corresponding wooden sailing ships of the middle of the 19th century.

The changes from sail power to steam power for propulsion, and from wood to iron and steel for constructional purposes, proceeded together, though at first very slowly. The marine steam engine was at first a very imperfect motor, and the services upon which steamships could be used to advantage were, in consequence, much restricted. There was, moreover, a national prejudice against the substitution of iron for “ the Wooden Walls of Old England.”

It is recorded that an iron boat, intended apparently for passenger service, was built and launched on the river Foss, in Yorkshire, in 1777, and shortly afterwards iron was used for the shell plating of lighters for canal service. One of these, having its shell constructed of plates five-sixteenths of an inch thick, was built near Birmingham in 1787. About the same time parts of wooden ships began to be replaced by iron, the first being beam knees. Early in the 19th century iron “ diagonal riders ” for providing the longitudinal strength were introduced by Sir Robert Seppings, and from this period down to the present day iron strengthenings for resisting both transverse and longitudinal strains have been generally used in wooden ships. The introduction of iron as a recognized material for ship construction is often given as dating from 1818, when the lighter “ Vulcan ” was built on the Monkland canal, near Glasgow.

Among the early objections were: (1) from its weight iron could not be expected to float, and was therefore unsuitable for the construction of a floating body; (2) when a ship constructed of this material grounded and was exposed to bumping on a shore, the bottom would be easily perforated; (3) the bottom could not be preserved from fouling by weeds and barnacles; and (4) the iron affected the compass, making it untrustworthy, if not useless. Gradually, however, the material made its way, and the objections to it proved to be for the most part untenable. Objection (1), although often repeated, was proved to involve a fallacy. With regard to objection (2) it was found that iron ships might ground and be subjected to a great deal of bumping and rough usage without being destroyed, and that, on the whole, they were better off in this respect than wooden ships. On more than one occasion when iron and wooden ships were stranded together by the same gale and in approximately the same circum- stances, the iron ships were got off, and, apart from local injury, were found to be little the worse for the grounding, while the wooden ships were either totally wrecked, or, if got off, were strained to such an extent as to be beyond repair. The power of resistance of iron ships to the strains produced by grounding received, in 1846-1847, a remarkable confirmation in connexion with the grounding of the “ Great Britain,” the first large screw steamer built of iron. This ship had been initiated by, and built under the supervision of, Mr I. K. Brunel, who had bestowed much attention upon the details of her construction. In 1846 she ran ashore in Dundrum Bay, in Ireland, and settled on two detached rocks; and although she remained aground for eleven months, including a whole winter, she was subsequently got off and repaired, and afterwards did good service. As regards (3), the fouling of the bottom, this evil, although not preventable,