made in the freeboards for vessels with complete superstructures or a considerable extent of strong deck erections, and in those for large vessels, with the result that a considerable increase was given to the carrying capacity of British shipping. This was followed by a conference in Hamburg between eight delegates nominated by the British government—being practically the former committee—and eight German delegates. The conference resulted in an adjustment of the German freeboard tables previously in force, and Germany has adopted freeboard tables and regulations which are recognized by the British government in an Order in Council dated 21st November 1908. France and Holland have adopted the British tables, and the load line certificates issued by those countries are recognized in Orders in Council dated 22nd November 1909 and nth June 1910 respec­tively. Denmark, Sweden and Spain have also adopted the British tables, and as other maritime nations have the subject under con­sideration it is confidently expected that the load line regulations will become international. Under the provisions of the Merchant Shipping Act 1906 the British load line regulations now apply to all foreign ships while they are within any port in the United Kingdom.

Ships laden with grain have to comply with rules of the Board of Trade, which provide that for single-decked ships there shall either be provision for feeding the hold, or there shall not be more than three-quarters of the hold occupied by grain in bulk, the remaining one-fourth being occupied by grain or other suitable cargo in bags, bales or barrels, supported on platforms laid on the grain in bulk. For ships with two decks, grain in bulk in the ’tween-decks is for the most part prohibited ; but certain grains are allowed, provided there are separate feeders for hold and 'tween-decks, or else sufficiently large feeders to the ’tween- decks, and the hatches and other openings there made available for feeding the holds. In ships with two decks longitudinal grain-tight shifting-boards must be fitted where grain is carried either in bags or bulk; these shifting-boards must extend from beam to deck and from beam to keelson, and in the case of bulk grain must also be fitted between the beams and carried up to the very top of the space. The regulations also impose a fine not exceeding five pounds for every hundred cubic feet of wood carried as deck cargo which arrives in a ship, British or foreign, in any port of the United Kingdom between the 31st October and 16th April, provided no unforeseen circumstances, as defined by the Act, intervene. By deck cargo in this section is meant any deals, battens or other wood goods of any description to a height exceeding 3 ft. above the deck.

In 1890 a committee was appointed by the Board of Trade to deal with the spacing and strength of transverse water-tight bulk­heads and to make recommendations. The first matter submitted to this committee related to subdivision which should enable a ship to float in moderate weather with any two compartments in free connexion with the sea. The committee, while recommending the above as a standard for sea-going ships of not less than 425 ft. in length, and for cross-channel steamers irrespective of length, suggested less stringent conditions for sea-going ships of shorter length. There was no suggestion of enforcing such subdivision by law ; but as a reward for complying some concession was to be allowed, under the Life Saving Appliances Act of 1888, as to the boats or life rafts to be carried. On the presentation of the report the matter was, however, allowed to drop, and the rules of *Lloyd's Register* and the other classification societies are therefore the only rules with practical influence. The subdivision required by *Lloyd's Register* for all steamers comprises a bulkhead at each end of the machinery spaces, and a bulkhead at a reasonable distance from each end of the ship, making four in all. In addition for larger steamers other bulkheads have to be fitted, making the total as follows, namely:—

Length of Steamer. . Bulkheads.

285 ft. to 335 ft 5

335 » 405 6

405 .> 470 7

47° .. 54° 8

540 " 610 „ 9

610 " 680 10

The positions of these additional bulkheads, and the height to which they are to be carried, are clearly stated, and the rules are given for their scantlings. These scantlings are suitable for purposes of safety in the event of accident; but it is understood that they have to be considerably increased when the bulkhead is also used to withstand frequently the pressure of oil or water ballast; a deflection of the plating which would do no harm in an emergency once en­countered would certainly become serious if often repeated in the ordinary service of the ship. The foremost bulkhead of the ship receives the name of *collision* bulkhead, or sometimes *fore-peαk* bulkhead; the aftermost, the *after-peak* bulkhead. In sailing ships the collision bulkhead alone requires to be fitted.

Practical

Practical shipbuilding requires a knowledge of the properties of the materials used in the construction of ships, and of the processes by which they are produced or prepared for use, so that they may be suitably selected for the services for which they are intended; also a knowledge of the methods, means and machinery by which, after delivery in the shipyard, the materials are brought to the requisite shape, erected in their proper relative positions, connected together, and completed so as to form a structure which shall fulfil the intentions of the design, whether large or small, merchant ship or warship. The varieties of ships are very great, and are constantly changing, and thus new problems continually present themselves to the shipbuilder. There is also an ever-increasing demand for rapid production, which necessitates a rigorous and constant search for simplification of methods of work, for labour-saving and time-saving machinery, for improved means of handling material in the shipyard, «and for workshops and factories which will more completely prepare and finish their various products before despatch to the shipyard.

Whatever the size of the ship or the type to which she belongs, the general principles of construction remain very much the same in all cases. The following account applies to steel and iron shipbuilding. The exterior parts—the bottom, sides and decks—supply the strength required for the structure as a whole. The bottom and sides are spoken of as the *shell* or *outside plating,* and are, with the decks, kept to the proper shape by means of frames running across the ship, like the rafters in a roof or the ribs in the body. These are called *transverse frames* or *ribs,* and *beams* where they run under the decks. The parts of the frames at the bottom of the ship, where they are made deep and strong to support her when she is docked or grounded, are known as *floors,* while the spaces between these floors are spoken of as the *bilges.* The transverse frames and floors are held upright in their proper relative positions by other frames which run lengthwise in the ship; one at the middle line being called the *centre keelson,* and others fitted at the sides, *keelsons, bilge keelsons* and *side stringers.* All the fore-and-aft frames, taken together, are spoken of as the longitudinal framing. Where tanks for carrying water ballast are built into the bottom of the ship, the centre keelson is called the *centre girder,* and the keelsons or bilge keelsons the *side girders.* In large merchant vessels, and in all war vessels, except the smallest classes, an *inner bottom* is provided for increasing the security against injury by grounding, and against ramming and torpedo attack in war vessels, in addition to forming tanks for carrying water, either as ballast or for use in the ship. In such cases the centre keelson is called the *vertical keel,* and the keelsons and girders are called *longitudinals.* When the deep vertical transverse plates forming the floors only extend between the keelsons, girders or longitudinals, and arc attached to them by angle bars, the floors arc called *intercostal* floors, and the keelsons, girders and longi- tudinals are said to be *continuous·,* on the other hand, when the keelsons, girders or longitudinals extend only between the frames and floors they are called *intercostal* keelsons, girders and longitudinals, and the frames and floors are said to be *continuous.* In war vessels, except the smallest classes, much of the longitudinal framing is continuous; and the transverse framing, for the most part, is *built up* of angle bars upon the outer bottom and under the inner bottom, with short plates, called bracket plates, between them, attached to the longitudinals by short angle bars. Frames built up in this way are called *bracket frames.* In mercantile vessels the transverse frames both within and without the double bottom are usually continuous.

Besides the transverse and longitudinal framing, there are partitions used for dividing up the internal spaces of the ship, which are called *bulkheads;* they are partial, complete, water- tight or non-water-tight, as the circumstances of the case require. In warships the transverse bulkheads are so numerous, in order to restrict as much as possible the entrance of water from damage in action, that they go a long way towards providing the necessary transverse strength, and the transverse frames are consequently made of thinner materials and fitted at greater distances apart than they otherwise would be. Transverse frames are from 36 to 48 in. apart in large warships, and from 24 to 33 and some­times 36 in. in large merchant ships. At the extreme ends of the ship the shell plating on the two sides is attached to forgings