bars extending to the upper deck; each tier of beams is securely riveted to them, and their lower ends are connected to the margin plate by strong brackets. At intervals the channel-bar frames are replaced by deep buiít-up frames, the frequency *of* which depends on local requirements. Heavy side stringers of the same depth as the deep frames run fore and aft, to stiffen the side between the bilges and the first plated deck. Where the deep frames are cut by these stringers, the strength of the frames is continued by *gusset* plates, as shown.

Some further structural arrangements usually adopted in British ships are shown in figs. 113 to 115. Fig. 113, to which reference has already been made, shows in detail the construction of a bulkhead, with the framing in wake of it, and the same details at an ordinary frame; also the stringers, beams, pillars, *&c.* The bulkhead itseíf stops at the tank top, being secured to it by double angle bars, and the floor immediately beneath it is made water-tight. It would involve very costly work to make the bulkhead water-tight if the side and bilge stringers were made continuous; these have therefore been cut, and the continuity of the longitudinal strength is main- tained, as far as possible, by the large brackets shown in the plan. Besides bulb stiffeners, the bulkhead is provided with built-up vertical stiffeners at AB and a built-up horizontal stiffener at CD. Fig. 114 shows the arrangement for special strengthening at the extreme fore end of a vessel, between the collision bulkhead and the stem, and below the main deck, these consisting chiefly of panting stringers, panting beams and breast hook. Fig. 115 shows the general arrangement of stern framing of a single-screw ship, including the shaft tunnel. A water-tight door, which can be closed when necessary from above the level of the outside water, shuts off communication between the engine-room and tunnel; the form of the stem post and aperture frame easting is shown, with its attachment to the centre keelson and other details.

Figs. 116 and 117 show the arrangements of the stern and bow framing of the “ Campania,” which may be taken as those usually adopted in large passenger steamers of this class.@@1 In both the transverse framing becomes deeper and stronger as the extremities are approached, while the decks and side stringers are all continued to the extremities, finishing in strong breast-hooks, and additional stringers, breast-hooks and panting beams are introduced. It is worthy of note that the rudder and steering gear are in this vessel entirely under water, so that she may be used for war purposes without running the risk of disablement by the rudder or steering gear being struck by projectiles. Above the water the stem is finished off so as to have the appearance of being fitted with an ordinary rudder. This important departure from the usual practice was first introduced by Professor Biles in the “ City of Pans,” and the “ Campania ” and her sister the “ Lucania ” were in 1902 the only British ships so fitted.

Fig. 122 gives in perspective the general structural arrangements of the Japanese cruiser “ldzumo," and figs. 118-121 (Plate XIV.) are from photographs of the vessel in course of construction. It will be seen that the departures from the structural arrange­ments of a merchant ship are very considerable. As already pointed out, lighter scantlings are used in warships than in ordinary merchant ships. This is effected by more carefully devised and more costly arrangements of framing and plating, and by making the structural features necessary in a warship for protection, &c., serve also for local and general strength.

In warships, frames are placed at greater distances apart, 4 ft. amid­ships and 3 ft. at the extremities being the usual spacing, as compared with some 2 ft. in a merchant ship. On the other hand, there are more continuous longitudinals in the framing of a warship, which extend in depth from the inner bottom to the shell-plating, and give

@@@1 We are indebted to the late Dr Elgar, F.R.S., for these and other plans of the “ Campania.”