of several pieces of tough rectangular timber, 4 to 6 ft. in length, and laid on each other to the height required. The top block is called the *cap-piece,* and is of oak or other hard wood. The blocks are spaced about 4 ft. apart for ships of medium size, and somewhat less for ships of large size. They are usually placed upon a longitudinal bed of timber, which remains embedded in the ground for successive ships; the ground should be hard, or very well piled, otherwise the blocks may sink when weight becomes concentrated over them during building, and difficulty arises from the keel, or the propelling shafts, drooping from a straight line. The upper surface of the blocks must be at such a height from the ground that men, especially riveters, can do their work with facility under the bottom of the vessel, that the launch can be fitted; and that when launched the vessel may move down into the water without striking the ground. The last-named is a most important consideration; and thus it comes about that the first thing to be settled, before the blocks are laid, is how the vessel is to be launched. The tops of all the blocks are accurately adjusted to a plane surface sloping about ⅝ in. in a foot from bow to stern. The shipwrights at the same time prepare the uprights for the staging, and erect them around the building berth in suitable position with the first line of staging, which will be required at an early period in the ship's construction. The platers and angle-smiths begin to prepare the keel, framing, bulk- heads, &c., as soon as the material is delivered and the laying-off and mould-making are sufficiently advanced for the purpose. The actual building generally dates from the first work of this character.

The keels of small vessels usually consist of a stout flat bar placed vertically and attached to the garboard strakes by through rivets. Occasionally the keel consists of a vertical centre through-plate, with side bars at its lower edge. In large merchant ships, and in war vessels, the keel usually consists of a wide horizontal plate running along the centre line of the bottom, the sides being turned up as necessary to follow the shape of the bottom (see figs. 118 and 119, Plate XIII.). The framing varies very considerably with the size and type of the ship, as already described. In small vessels a frame usually consists of an angle bar, called a *frame bar,* extending from gunwale to gunwale, to which is riveted a bar, also continuous from gunwale to gunwale, called a *reverse bar,* in such a way as to form a built-up Z-bar, and between these floor-plates are introduced across the bottom, to give the required strength when resting on the ground or on the blocks. Sometimes the frame consists of a Z-bar, in which case the *reverse bar* is not required in the vicinity of the floor-plate. Sometimes angle bulbs are used for frames, as in the case of oil steamers, where internal ceilings are not required. The process of constructing a complete frame of angle bars and plate is as follows: From the scrive-boards the shape of the section at the frame is transferred to the bending blocks or slabs, the outline being drawn in with chalk; the necessary preparation is made, and the frame bar is drawn from the furnace, and while hot bent to its shape and given the required bevel. The reverse bar is prepared in the same way, except that the inner edge of the frame and floor must be worked to. The floor- plate has to be cut to shape. In large ships the *frame bars, reverse bars* and *floor-plates* will be in two, or even in three, pieces ; in this case the butts are kept some distance from the middle line, and are *shifted* in alternate frames, so as not all to lie in the same fore-and- aft lines. The butts of both frame and reverse bars, as well as those of the floor-plate, are butt-strapped, to maintain as much as possible the strength of the structure. The frame bar, floor-plate and reverse frame bar all being set, they are placed together in their respective positions over the outline of the frame on the slabs or scrive-boards, the final adjustments made and rivet holes marked and punched, and the work secured together and riveted up.

When the keel is in place, and as far as possible riveted, the frames, bulkheads and beams, which have been made ready by the iron-workers, are brought to the building slip and got into position by the shipwrights. They are held in place and faired by means of shores and *ribbands.* The latter are made from straight­grained timber of considerable length, sawn out in long straight pieces of square transverse section. They hold the frames in position until the outside plating is riveted. Upon them are marked the lines at which they must be crossed by each frame, and they are bent round and attached to the frames in a fore-and-aft direction at certain heights, which are marked on the frames at the scrive- boards. Some four or more ribbands are used each side of the ship. As the work proceeds, the positions of the frames and ribbands arc checked continuously, their positions being maintained by shores from the ground, or some structure prepared for the purpose. Except in small vessels, the beams are not attached to the frames before they are erected, but are hoisted into place as soon as possible afterwards.

The bulkheads are put together on some convenient flat surface, sometimes on the scrive-board or a similar platform constructed for the purpose. If of large size, they are transferred piece by piece and erected at their proper positions in the ship; but when­ever possible, they are rivited up and hoisted into position complete. The stem and sternpost are obtained from the forge or foundry and erected at an early stage of the work. The part of the stern abaft the transom is sometimes framed separately on the ground before being erected in the ship. The centre keelson is generally worked intercostally between the floors, but it has continuous parts, usually angle bars, above the floors. Each intercostal plate is secured by angle bars or flanged edges to the floors and to the flat keel plate. Sometimes it is continuous, especially in large ships and in war- ships. The frames are then cut by it, and the floor-plates arc attached to it by short angle bars. After the centre keelsons, the side keelsons and side and deck stringers are fitted. The steel pillars arc substituted for the shores supporting the deck beams, being riveted at their heads to the beams and at their heels to the keelson, inner bottom or tank top.

While the work is proceeding, the shipwrights make the stages, put up gangways and ladders for carrying on the work, fit extra blocks and shores, or remove and replace them as may be required. They line off all plate edges on the frames, the overlap being usually painted in with white paint, ready for the platers. They also erect the stem, sternpost, rudder and shaft brackets, or struts in twin- screw vessels.

In a ship fitted with an inner bottom the procedure is somewhat more complicated, as the transverse frames cannot be lifted into place as a whole. There are many varieties in the arrangements in such cases; one frequently adopted is shown in fig. 113, in which the inner bottom extends out to the turn of the bilge. This figure also shows the general construction of the vessel, including the framing at a bulkhead and elsewhere, the bulkhead itself with all its stiffening bars and attachments to the sides of the vessel, and the inner bottom. At the centre line, immediately over the flat keel plates, there is a vertical girder, the full depth of the double bottom, connected to the flat keel plate and to the centre plate of the inner bottom by continuous double-angle bars. This centre girder may or may not be water-tight, according to the desired tank arrangements. The transverse frames arc in four parts: the two lower extending on either side from the centre girder to the margin plate of the double bottom, which is a continuous girder of special construction; and the two upper, from the margin plates to the top-sides. The lower parts consist of a floor-plate with angle bars at its edges for attaching it to the outer and inner bottoms, the centre girder and the margin plate. At the bulkheads these floor- plates are solid, and the angle bars are united and made water- tight; elsewhere they are lightened by holes, and the angle bars at their upper and lower edges and ends are separate pieces. The two upper parts of the transverse framing consist of a frame and a reverse bar, each having a deep and a shallow flange, and are riveted to one another along their deep flanges, with their shallow flanges standing the reverse way to one another. The shell-plating is attached to the shallow flange of the frame bar. Between the centre girder and the margin plate on each side of the ship there are two intercostal girders, the plates of which are connected by short angle bars to the floors and to the shell and inner bottom plating; and between the margin plates and the lower deck on each side there are three stringers, consisting of intercostal plates attached by short bars to the outer plating, and three continuous angle bars riveted to part of the intercostal plates which extend beyond the reverse bars.

In the course of erection, after the flat keel plate is laid upon the blocks, and the centre girder placed upon it, the two lower parts of the frames, which have been constructed alongside, are put into position, their outer ends being carried by ribbands shored from the ground. The intercostal girders and margin plates are then fitted. The lower edge of the margin plate is brought close to the outer edge of the frames, and is connected by a longitudinal angle bar to the shell-plating, while its upper edge is flanged for the purpose of being attached to the inner bottom plating. The ship at this stage gives the impression that a flat pontoon is being constructed.

When the margin plates are up and faired and, as far as desirable, riveted, the upper parts of the frames on each side are erected and the fairing proceeded with as before. The beams are now got into place, also the side and deck stringers. As will be seen, the margin plate cuts completely through the transverse frames, and special brackets are provided to maintain the transverse strength. The chief advantages derived from cutting the frames by the margin plate are the cheapness with which water-tight work is secured, and the rapidity with which this part of the work can be proceeded with.

As soon as the keelsons and stringers are riveted, and the ship by their means sufficiently stiffened, the outside or shell plating is commenced. The plating squad is supplied with a drawing showing the disposition of the butts in each line of plates; light wooden moulds or templates are then made, giving the exact shape of the edges and butts, and the positions of all the rivet holes in the frames. From these moulds the edges and butts and the holes are marked off, the holes are punched, and the edges and butts sheared and planed. The plates are then rolled to shape, furnacing being resorted to only when the curvature is too extreme to be obtained with the plate cold. The usual arrangement of the plating is that of inside and outside strakes alternately (sec *a,* fig. 79). The inside strakes, which are worked first, are templated off the ship, and lie directly on the flanges of the frame bars. The outside or overlapping