vertical planes. In the cant bodies the sides of the frames are not square to the line of the keel, but are inclined aft in the fore-body and forward in the after-body. The reason for the frames in these portions of a wooden ship being canted is that, in these parts of the ship, the timber would be too much cut away on account of the fineness of the angle formed between an athwartship plane and the outline or water-line of the ship. The timber is there­fore turned partially round till the outside face coincides nearly with the desired outline, and it is by this movement that the side of a frame in the cant fore-body is made to point aft, and in the cant after-body to point forward.

In wooden ships the term “timbers” is sometimes applied to the frames only, but more generally to all large pieces of timber used in the construction. Timbers, when combined together to form an athwartship outline of the body of a ship, are technically called frames, and sometimes ribs.

The keel, in the United Kingdom at least, is generally made of elm, on account of its toughness, and from its not being liable to split if the ship should take the ground, though pierced in all directions by the numerous fastenings passing through it. It is generally composed of as long pieces as can be obtained, united to each other by horizontal scarphs. The rabbet of the keel is an angular recess cut into the side to receive the edge of the planks on each side of it. The keel is connected forward to the stem by a scarph, sometimes called the boxing scarph, and aft to the stern- post by mortice and tenon. The apron is fayed or fitted to the after-side of the stem, and is intended to give shift to its scarphs, the lower end scarphs to the deadwood. The keelson is an internal line of timbers fayed upon the inside of the floors directly over the keel, the floors being thus confined between it and the keel. Its use is to secure the frames and to give shift to the scarphs of the keel, and thus give strength to the ship to resist extension length­ways, and to prevent her hogging or sagging. The foremost end of the keelson scarphs to the stemson, which is intended to give shift to the scarphs connecting the stem and keel. The frames or ribs are composed of the strongest and most durable timber obtainable.

The floors in the Government service were carried across the keel

principal action of these forces is to alter the vertical angle made by the beam and the ship’s side—that is, to raise or depress the beam, and so alter the angle between it and the side of the ship above or below it. On the lee-side the weight of the weather side of the ship and all connected with it, and of the decks and everything upon them, as well as the upward pressure of the water, all tend to diminish the angle made by the beam and the ship’s side below it, and consequently increase the angle made between them above it. The contrary effect is produced on the weather side, where the tendency is to close the angle above the beam and open that below it. If the beam, when subjected to these strains, be considered as a lever, it will be evident that the fastenings to prevent its rising ought to be as far from the side as is consistent with the convenience or accommodation of the ship, and that, while the support should also be extended inwards, the fastening to keep down the beam-end should be as close to the end of the beam, and consequently to the ship’s side, as it can be placed.

The plank, or skin, or sheathing of a ship, both external and internal, is of various thicknesses. A strake of planking is a range of planks abutting against each other, and generally extend­ing the whole length of the ship. A thick strake, or a combina­tion of several thick strakes, is worked wherever it is supposed that the frame requires particular support—for instance, internally over the heads and heels of the timbers, both externally and internally in men-of-war vessels between the ranges of ports, and internally to support the connexion of the beams with the sides and at the same time form a longitudinal tie. The upper strakes of plank, or assemblages of external planks, are called the sheer- strakes. The strakes between the several ranges of ports, begin-

with a short and long arm on either side alternately, so as to break joint, and between the frames the space was filled in solid.

Longitudinal pieces of timber are worked round the interior of a ship for the purpose of receiving the ends of the beams of the several decks ; they are called shelves, and are of the greatest importance, not only for this purpose, but also as longitudinal ties and struts.

The beams of a ship prevent the sides from collapsing, and at the same time carry the decks. The beams are spaced, and their scantling settled upon, according to the strength required to be given to the decks, and to suit the positions of the masts and hatchways, and other arrangements connected with the economy of the ship. All beams have a curve upwards towards the middle of the ship, called the round-up. This is for the purpose of strengt h, and for the convenience of the run of the water to the scuppers. Wooden beams are single piece, two, three, or four piece beams according to the number of pieces of timber of which they are composed. The several pieces are scarphed together, and dowelled and bolted, the scarphs being always vertical.

The connexion of the ends of the beams to the sides of the ship has been made in various ways. The points to be considered, with re­ference to this connexion, are—that the beam is required to act as a shore or strut, to prevent the sides of the ship from collapsing, and also as a tie to prevent their falling apart, that the beam shall not rise from its seat, and that it shall not work in a fore-and-aft direction.

That the beam may be an effective shore, nothing more is neces­sary than that the abutment of the end against the ship’s side may be perfect. In order that it may act as a tie between the two sides, it is generally dowelled to the upper surface of the shelf on which it rests ; and the under surface of the waterway plank which lies upon it is sometimes dowelled into it. These dowels, therefore, connect it with the shelf and the waterway, and through this means it is thus connected with the sides of the ship.

From the short outline previously given of the disturbing forces acting on a ship it will be seen that the strain on the ends of the beams to destroy their connexion with the side and loosen the fastenings must be very great when the ship is under sail, either on a wind or before it—that is, either inclined or rolling. The

ning from under the upper-deck ports of a three-decked ship in the British navy, were called the channel wale, the middle wale, and the main wale. The strake immediately above the main wale was called the black strake. The strakes below the main wale diminished from the thickness of the main wale to the thickness of the plank of the bottom, and were therefore called the diminishing strakes. The lowest strake of the plank of the bottom, the edge of which fits into the rabbet of the keel, is called the garboard strake.

Plank is either worked in parallel strakes, when it is called “ straight-edged, ” or in combination of two strakes, so that alternate seams are parallel. There are two methods of working these com­binations, one of which is called “anchor stock,” and the other “top and butt.” The difference will be best shown by fig. 13. The difference in the intention is that in the method of working two strakes anchor-stock fashion, the narrowest part of one strake always occurs opposite to the widest part of the other strake, and consequently the least possible sudden interruption of longitudinal fibre, arising from the abutment, is obtained. This description, therefore, of planking is used where strength is especially desirable. In top and butt strakes the intention is, by having a wide end and a narrow end in each plank, to approximate to the growth of the tree, and to diminish the difficulty of procuring the plank. When the planking is looked upon as a longitudinal tie, the advantage of these edges being, as it were, imbedded into each other is apparent, all elongation by one edge sliding upon the other being thus prevented. The shift of plank is the manner of arranging the butts of tho several strakes. In the ships of the British navy the butts were not allowed to occur in the same vertical line, or on the same timber, without the intervention of three whole strakes between them.