

is to be lifted by one purchase, and one on each side if two are used, and as high up as the shears will allow, the limit being from heel to lashing 6 or 8 feet less than from the lower side of the purchase-block to the deck. Old spars having been hung over the side for the mast to rub against and the purchase fall taken round the capstan, the mast is hoisted up till the head comes above the gunnel; then two single blocks with long-tailed strops are secured round it with the gird-lines of about 4 inches and twice the length of the mast ready rove. The trestle-trees

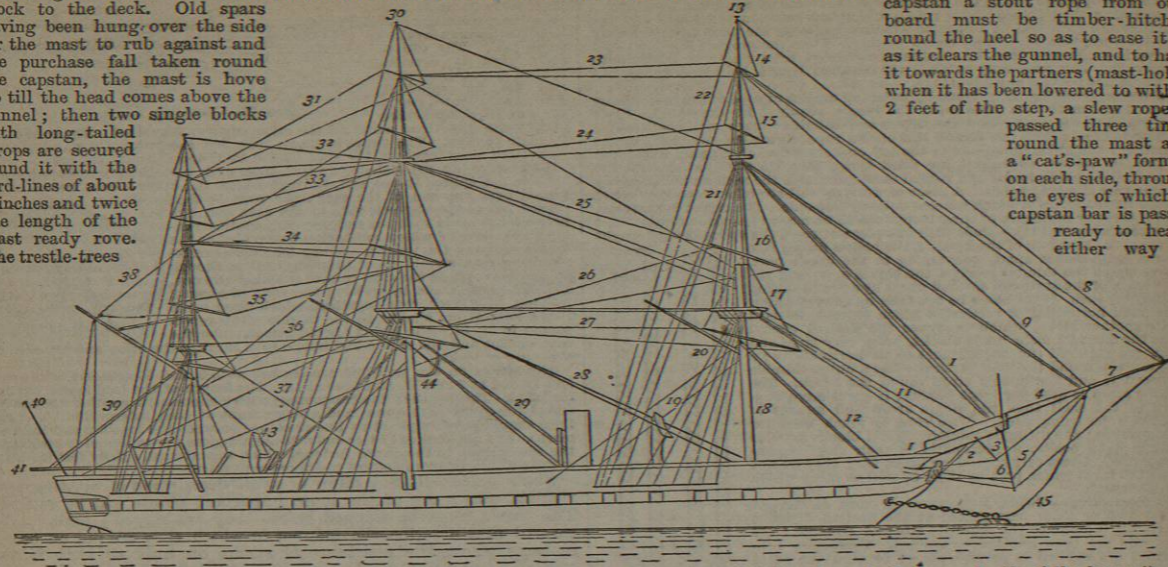


FIG. 35.—The spars and rigging of a frigate. 1, the bowsprit; 2, bobstays, three pairs; 3, sprit-sail-gaffs, projecting on each side of the bowsprit,—the ropes at the extremities are jib-guys and flying-jib-guys; 4, jibboom; 5, martingale-stay, and below it the flying-jib-martingale; 6, back-ropes; 7, flying-jibboom; 8, fore-royal-stay, flying-jib-stay, and halyards; 9, fore-top-gallant-stay, jib-stay, and halyards; 10, two fore-top-mast-stays and fore-top-mast-stay-sail halyards; 11, the fore-top-bowlines, stopped into the top and two fore-stays; 12, two fore-tacks; 13, fore-truck; 14, fore-royal-mast, yard, and lift; 15, top-gallant-mast, yard, and lift; 16, fore-top-mast, top-sail-yard, lift, and reef-tackle; 17, fore-top, fore-lift, and top-sail-sheet; 18, fore-mast and fore-shrouds, nine pairs; 19, fore-sheets; 20, fore-gaff; 21, fore-top-mast back-stays and top-sail-tye; 22, royal and top-gallant back-stays; 23, fore-royal-braces and main-royal-stay; 24, fore-top-gallant-braces and main-top-gallant-stay; 25, standing parts or fore-top-sail-braces and stays; 26, main-truck; 27, main-royal-braces; 28, mizzen-royal-stay and mizzen-royal-braces; 29, four parts of fore-braces; 30, main-stays; 31, main-tacks; 32, main-top-mast-stays; 33, hauling parts of fore-top-sail-braces and main-top-bowlines; 34, standing parts of main-top-sail-braces and mizzen-top-mast-stay; 35, mizzen-top-sail-braces; 36, hauling parts of main-top-sail-braces, mizzen-top-bowlines, and cross-jack-braces; 37, main-braces and mizzen-stay; 38, standing part of peak halyards; 39, vangs, similar on each gaff; 40, ensign staff; 41, spanker-boom; 42, quarter-boat's davits; 43, one of the davit topping-lifts and wind-sail; 44, main-yard-tackle; 45, a bull-rope.

required; in the meantime both the heel of the mast and the step should be well coated with white lead or coal-tar. Lower and steeper according to directions from below; when the mast is stepped and brought to the desired position, place four temporary wedges, rig a triangle, trice it up by the gird-lines, unlash the purchase or strops, overhaul down, unrig the triangle, and haul the gird-lines taut on each side.

The shears can be transported forward in nearly an upright position by first pulling the heel-tackles and then the guys, shifting the guys forward one at a time as necessary. The main-mast and the fore-mast are taken in in the same way as the mizzen-mast, described above,—all three abaft the shears; but, being much longer, they require greater hoist and greater care generally.

To take in the bowsprit the shears are again moved forward, all the heel-tackles being led forward and extra lashings placed on the heels. A purchase nearly as strong as that to be used in lifting the bowsprit should be secured between the fore-mast-head and the shear-head, or two parts of a stout hawser may be used, the middle being clove-hitched over the horns and the ends taken round beams well aft on either side, ready for veering as the shears are drooped (to an angle of about 45°), then to act as the principal support; the fore-guys are also taken aft to assist. The fore-mast must be wedged on both decks and one or more tackles used to keep the head aft. The bowsprit cap is invariably bolted on in the mast-house; the bowsprit is then brought under the bows with the cap end forward and slung for the main purchase a little

¹ References are not repeated for each mast where the names and functions are identical.

are now usually bolted on in the mast-house. The gird-line from the shear-head must be bent to the head of the mast at a suitable height to act as a topping-lift. As the mast is hoisted up by the capstan a stout rope from out-board must be timber-hitched round the heel so as to ease it in as it clears the gunnel, and to haul it towards the partners (mast-hole); when it has been lowered to within 2 feet of the step, a slow rope is passed three times round the mast and a "cat's-paw" formed on each side, through the eyes of which a capstan bar is passed ready to heave either way as

outside the housing, which is generally about two-fifths of the whole length. The main purchase should plumb nearly the length of the housing outside the bows, and the higher the shear-head the greater the freedom of motion. The outer purchase attached to a strop through the hole in the cap and the guys from the cap to each cat-head alike tend to force in the bowsprit when it is high enough; besides this, a heel rope is put round it before it leaves the water, and a strop with a tackle to the bitts is used to bowse it into the hole and mortise. It is hoisted to about an angle of 45° before the heel is entered. A rough sketch made to scale will greatly facilitate such operations and ensure success. When a bowsprit is put in by shears on a hulk or jetty, it is hoisted up ahead of the ship nearly horizontal, or at the angle (steeve) which it is intended to assume, and the ship is moved ahead towards it, till the bowsprit enters in the desired position.

The directions for masting a large ship are more than sufficient for masting a small one, which is so much easier.

Gammoning the bowsprit is the most important point in rigging a ship, as the stays of the fore-mast and main-top-mast depend for security on the bowsprit. In large ships there are two distinct lashings (of either new stretched rope or chain) to keep the bowsprit down; they are passed in a similar manner over a long saddle-shaped piece of wood called a gammoning fish and through the holes in the head knees, the outer one first. One end is clinched or shackled round the bowsprit over the fore-part of the hole; the

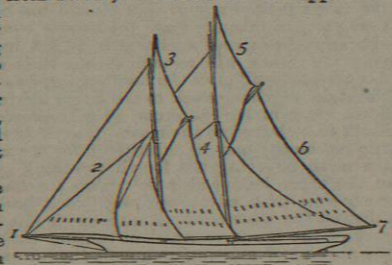


FIG. 36.—Schooner yacht. 1, bowsprit, with martingale to the stem; 2, fore-top-mast-stay, jib, and stay-fore-sail; 3, fore-gaff-top-sail; 4, fore-sail and main-stays; 5, main-gaff-top-sail; 6, main-sail; 7, end of boom.

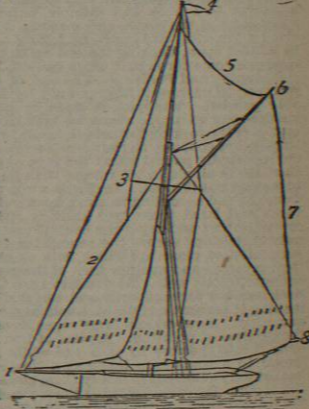


FIG. 37.—Cutter yacht. 1, bowsprit and martingale; 2, jib,—behind it is the fore-sail; 3, cross-trees and top-mast-shroud; 4, pennant designating the club to which she belongs; 5, gaff-top-sail; 6, peak of gaff, hoisted by peak and throat halyards; 7, main-sail; 8, end of boom and topping-lift.

other, being rove through the after-part of the hole, comes up on the aft side of the first turn on the bowsprit and down inside that part and before the turns in the hole, thus forming a double cross with the first turns outside. Every turn is set up as passed by means of a pendant through the hawse-pipe or bow-port, and a block is secured to the hole for the bobstays, which are attached to the gammoning by a selvage or toggle, and held while the next turn is being passed by a racking seizing if rope and by nails driven through the links into the fish if chain. When the hole is full of turns—eight or ten—the whole is frapped together as tightly as possible, commencing at the lower part.

The clothing of a bowsprit of a large ship consists of nine strops for its own security and the fore-stays. A bobstay collar is hoisted on at one-third the distance between the night-heads and the outer extremity, and close outside it two bowsprit shroud collars and a fore-stay collar, then the second bobstay collar, two bowsprit shroud collars, another fore-stay collar, and the third bobstay collar; in addition to these there is a cap bobstay, which sets up to a bolt close inside the bowsprit cap. The bobstay and bowsprit shroud collars are hoisted on at right angles to the spar and usually cleated in that position. But this cleating is a mistake; as the strain comes upon each of them very obliquely, it is necessary that they should yield in that direction before the cleats are nailed, or they will give way and slacken the rope when it is most required to be taut. Bobstays are cut to the required length, wormed and parcelled from the centre towards the ends, and served; they are rove through their respective holes in the cutwater before being spliced, which splice is tapered, parcelled, and served over, and rests on the head of the heart when it is seized in. The bobstays and bowsprit shrouds are set up by lanyards half the nominal size if rope and the same size if wire; the standing parts are secured by running eyes round the necks of the collars confining the hearts, and are set up by two luffs, one acting upon the other.

The cross-trees are swayed up one at a time by the two gird-lines, whose united action and a guy on deck conduct them to their places, where they drop into recesses and are bolted to the trestle-trees. When a whole top is to be got up it is placed abaft the mast (except the mizzen) with the lower side forward and the fore part uppermost; the gird-lines are passed under it, that is, before it, each being rove up through the second hole from aft for the futtock-plates and hitched tightly to its own part as it passes the lubber's hole, which part is also stopped to the hole at the fore part of the top. If it be a large top each gird-line may be taken down the fore (under) side (as before), rove up through the after-hole for the futtock-plate, down through the lubber's hole, taut up through the foremost hole, and hitched to the hoisting part, which is stopped firmly to the fore part, where a gird-line leading from the mast abaft is also stopped after the end has been made fast to the centre hole for the top-rail; that gird-line is to keep the top clear of the trestle-trees as it goes up and to assist in placing it. There are several slightly different ways of slinging a whole top; but in all cases the gird-line blocks (after the stop is cut) hoist the fore part higher than themselves, till it falls over them and hangs as nearly horizontal as could be judged in slinging it. The final adjustment of it in its place is done by hand, and then it is bolted to the cross-trees. The mizzen-top is put over either in a similar manner with a guy to the taffrail or sent up before the mast with the after part uppermost, a gird-line from the main-mast-head keeping it clear of the trestle-trees, which project much farther on the fore side. Tops are taken off by the reverse process; but it is more difficult to get the hole back over the mast-head.

Tops are now very seldom made in one part, but in two halves, which is more convenient and equally serviceable. Each half is sent up in a similar manner to the whole top; the gird-lines are bent on precisely the same way, but one half at a time, which falls square at the side of the mast when the stop is cut instead of going over the top of the mast. After the top is bolted, it is advisable to hoist up the lower cap into the top while the whole space of the lubber's hole is still free, but not to put it on till after the lower rigging is fixed. The cap being placed near the mast with the bolts downwards and the hole for the top-mast forward, both gird-lines are brought down through the lubber's hole on the same side; that which crossed before the mast is bent on to the fore part of the cap, and that which belongs to the side on which the cap is lying is made to sling the after part fairly and is then stopped to the fore part, so that this last is hoisted up by both gird-lines end on till in the top, when, the stop at the fore end being cut, the cap hangs in front of the mast and the round hole can be placed exactly over the space between the trestle-trees where the top-mast will come up. A soft piece of wood called a "bolster" is made to fit into the angle formed by the trestle-tree and the mast on each side, and is bolted in place so as to present a smooth rounded surface along the whole distance required for the rigging to rest upon, and is covered by a padding of tarred canvas five or six parts thick, secured by a row of flat-headed nails along the upper side. Each mast is similarly provided.

Preparatory to sending up the lower rigging on the masts it is

necessary to rearrange the gird-lines, as it is obviously inconvenient to hoist the eye of a shroud over the mast and allow it to fall down over both parts of a heavy rope which would require to be hauled up from the deck or rove every time; therefore they are lashed to the leads in the trestle-trees for the truss falls, and a small gird-line is lashed high up abaft the mast to be worked in the top for both sets of rigging. The starboard tackle-pendant is put over first, then the port pair, next the starboard foremost pair of shrouds followed by the port pair, and so on alternately till all the shrouds are in place, ending with an odd one called a swifter on each side. Large ships have four pairs of shrouds and a swifter on each side. They are all sent up in a similar manner: the large gird-line from the trestle-tree is secured to the pendant at the extremity and to the shrouds more than the length of the mast-head below the seizing by means of a strop with a slip-rope, toggle, and down-haul; the eye is opened to the shape of the mast-head and the after-part is stopped to the gird-line, which sways it up to the lubber's hole, when the men in the top bend the eye in the direction it is to go over the mast and make fast their small gird-line a fathom or two below the seizing, with a stop on the after part of the eye, which is cut when the pendant or shroud is fair for going over the mast-head. When the shroud is over, each eye is hardened down by a large mallet called a "commander." Ropes should be rove through the thimbles of the pendants and hauled taut when they are being driven down; then the "up-and-down" tackles should be hooked to the short legs (which are forward), while the long legs are being lashed abaft the mast and the runner-blocks lashed to them for staying the mast by the runners. As each pair of shrouds are put over, they should be temporarily set up by the dead-eyes and lanyards, or by a luff-tackle on each, to prevent their springing up before another pair presses upon them. It is of very great importance to keep each eye taut before others press on it both for preservation and appearance; many an eye has been stripped of its service and parcelled through slipping out from under the weight. A piece of rounding made fast to a bolt in the hounds of the mast with an eye in the other end is very useful for keeping the back of the eye down while it is being made taut, by reeving the short eye end up through the eye of the shroud and hooking a burton from the deck to it, which is pulled upon at the same time that the shroud is set up on the other side of the ship; when finished, that piece of rope will be jammed. The lower stays, after they have been completely fitted and the hearts have been turned in, are stopped together one over the other at the fork of the collar, at the sides, and at the eyes. The gird-lines, having been put back to the mast-head, are sent down through the lubber's hole, one crossing the fore side of the mast, and are bent to both stays below the fork of collars and stopped to the eyes; they are thus swayed up near their places, the respective eyes being lashed together by rove-lashings low down over the eyes of all the shrouds. The hearts are then carried forward, the fore to the hearts in collars round the bowsprit and the main to hearts provided for the purpose near the fore-partners, while the collars of the stays are suspended from the fore-part of the top, the collars being eased down as required to preserve a straight line between the lashing-eyes and the point where the stay is set up.

The following is the method employed to set up the rigging on the masts. It is first drawn forward by the runners and tackles (lashed to the long legs of mast-head pendants, which are lashed together abaft the mast) till brought before the position it is intended to stand in, as the strain of the shrouds will draw it aft. Many seamen recommend, with reason, that a strain should be brought on the after-swifters while it is being stayed, to keep it more firm. The propriety of wedging the mast before the rigging is set up may be considered an open question; it was considered lubberly forty years ago, but is now the common practice. The lanyards of the stays are in proportion smaller than those of the shrouds, since many more turns can be passed through hearts than through dead-eyes. The standing parts are made fast round the collar or strop of the lower heart by a running eye; the end is rove up through the heart in the stay and down through the lower one twice and the slack hauled through by the sail-tackle, which must be previously secured for that purpose round the lower mast-head and hung over the fore-part of the top; or the two top-burtons may be used, one for each stay. When the slack of the lanyard is through and racked, the double block of a luff-tackle is attached by turning the bight back over a toggle or glut, as slings are represented in fig. 18. Then a selvage strop is passed twice round both parts below the bight (when the figure is turned up), brought up on the side of the arrow, and hooked to the luff. A cat's-paw, as shown in fig. 7, may be used with a glut placed at *g* to keep the parts open, otherwise a large rope would be injured. The single block of the luff is secured to the stay as high up as it will reach by a long double-tailed selvage, which is dogged softly at first, but terminates with close-taut turns and a spanyarn seizing. Care must be taken to prevent kinking the rope, especially if it is wire; if hemp, it should be parcelled to protect the outer yarns. The fall of the luff is connected with the

sail-tackle (by one of the means described) and the sail-tackle fall led in the direction of the stay; it is pulled up steadily, the nips of the lanyards having been well tarred to make them slip through the hearts, while they are also shaken up by levers. When taut enough the lanyard is securely seized to the next part, another turn rove, set up, and seized, till the scores in the hearts are full; then riding turns are taken. Whilst the first riding turn still bears the strain, all the seizings on the lanyards should be cut off, and others put on when each part has taken over an equal strain. After the riding turns are completed, the end of the lanyard is secured by a clove-hitch and a seizing. Where there is not a sail-tackle a long luff may be used in a similar manner, the double block being secured above the single block of the other luff. It is desirable that both stays on the masts should be set up at the same time, but it is not imperative; care should be taken that they are equally taut.

A lanyard for rigging with dead-eyes is half the nominal size of rope shrouds and the same size as wire rigging. The knot is inside under the end of the shroud, or is first spliced to a bolt in the chains and then rove through that hole; it is rove full before commencing to set up. The mast having been stayed, luffs are placed on the shrouds with the double block down and brought to the lanyard as above described; the up-and-down tackle from the mast-head pendant is secured to the fall of the luff by a cat's-paw and stop and pulled up till taut enough, the foremost shroud on the starboard side first, then that on the port side, and so on alternately till they are all nearly taut alike (the after-swifters not quite so taut as the others), which is best ascertained by an experienced man shaking them; if the dead-eyes are not square (even) when finished, it is far better to turn them in afresh than to have an unequal strain on the shrouds. If a pair of shrouds were set up at the same time it would be better for the eye and the seizing. Tar should be used freely on the lanyards as they enter the dead-eyes, whether they are of iron or wood; it causes them to slip quite as well as grease and preserves the rope, while grease causes it to decay. The lanyards are seized to the next part till a clove hitch is taken above the dead-eye and the end seized down; the parts of the lanyard should then be made to bear an equal strain, and afterwards should be kept taut till everything is secured, then eased up gently, to avoid straining the mast. Lower masts generally have an inclination to belly,—i.e., bend aft. Space will not admit of details being given as to the various parts of the rigging; the main principles follow the lines of that which has been already rather fully described above. The top-mast stays and rigging are set up by means of top-burtons and jiggers, the top-gallant-rigging and that of all small vessels by jiggers and light appliances.

Lower cap and top-mast.

The lower caps were supposed to have been swayed up by the gird-lines and placed in position to receive the top-masts before the lower rigging was put over. To fix one of them in its place, let a top-block be hoisted up lashed to the mast-head close below the square on which the cap is to rest, on the side suitable to the sheave in the top-mast; through the block reeve a suitable hawser (9 inches for a large ship); send the fore end down through the square hole between the trestle-trees; lay it along the top-mast (the spare one if allowed two); reeve it through the live sheave in the heel; and hitch it round the head of the top-mast and hawser, leaving considerable end; also place a good lashing round the mast-head and the hoisting-part of the hawser and seize the two parts of the hawser together about half-way up, strong enough to bear the weight of the mast. If the top-mast be much longer than the space between the deck and the trestle-tree, the lashing must be placed low enough from the head of the mast to allow it, while suspended, to project above the top outside, while the heel is guided down the main hatchway or fore-scuttle. The capstan is used to heave the mast up; when it is pointed between the trestle-trees, remove the lashing round the head, and if landed—i.e., resting its weight on the deck—make the end of the hawser fast round the mast-head, the hitch being on the side opposite to the block, and cast off the racking lashing, leaving the mast ready to be hoisted up by the two parts of the hawser. If not landed, heave up 3 or 4 feet before securing the end of the hawser, so that, when that has been done and well seized, the capstan may be moved back till both parts bear an equal strain; the racking can then be taken off without fear of a jerk. After the head of the top-mast has been hoisted 3 or 4 feet through the hole in the cap, it is securely lashed, commencing with a clove-hitch round the mast, the ends being passed through the bolts under the cap on one side and repeated on the other, so that it will be sure to hang horizontally. Heave round the capstan till the cap is above the lower mast-head; then steer it by means of a handspike or capstan bar in the fid-hole, while men in the top direct the head of the top-mast by handspikes, till the hole in the cap is exactly over the square of the mast, when by moving back the capstan and beating the cap down with a commander it will fit firmly in its place.

If the heel of the top-mast rests on the deck before the head

is free from the trestle-trees, it is as well to lower it down to that position; but, if it is too short to rest there, the up-and-down tackles must be used to suspend it by strops through the fid-hole, while the top-block is being unlash and hooked to the after-bolt fixed for that purpose in the cap and the end of the hawser secured to the foremost bolt on the opposite side. In large ships a shore is placed under the fore-part of the cap to support the weight and resist a possible blow from the top-sail-yard. The top-mast may now (unless it is blowing hard) be swayed right up and fidded to prove that it will fit when required (an allowance being made for the wood swelling with wet), and sent on deck in exchange for the other mast, which when swayed above the lower cap will have a gird-line lashed round the head and then be raised 15 or 20 feet more. One part of the gird-line should be sent down abaft all and bent on to the fore-part of the top-mast cross-trees; by this, assisted by a guy, they can be swayed up till above the lower cap, upon which the after-part will rest, securely lashed to the bolts to prevent it slipping, while the fore-part will lean against the top-mast at such a distance as to ensure it falling in the right position when the trestle-trees as it is swayed up again to a convenient position for receiving the rigging. The rigging is swayed up by gird-lines on the cross-trees, and put over in a similar manner to the lower rigging, the top-burton pendants first, then the shrouds and backstays in succession, and the stays are lashed.

There is usually a chain necklace round each top-mast-head, sunk in the bolsters; one leg of each is for the top-sail-tye hanging-block to shackle to, and forward there are two other legs for the jib-halyards and fore-top-mast stay-sail-halyards. After the rigging has been placed over the top-mast-head, the cap is sent up by two gird-lines lashed as high as possible and bent to the foremost part of the cap, with stops to the after-bolts, by which means it goes up before all, with the under-side towards the mast; when it is high enough the after-stops are cut and it slides up on the top of the mast, assisted by men at the mast-head, who get it over the square and beat it down. Directly the top-mast is in position to receive the rigging the top-ropes pendants are rove and the tackles secured, first one to relieve the hawser of the weight and then the other in its place. Copper funnels are sometimes used to receive the top-mast rigging, similar to those for top-gallant-masts.

Top-gallant and royal rigging is sometimes stripped of the service and covered with canvas, which is afterwards painted, for the sake of neatness; but the durability of the rope is thereby greatly lessened. Another bad practice is that of taking off one of the top-gallant-backstays, thereby directly diminishing the support. But worse still is the trick of forming the eyes of rigging and backstays by two seizings, the ends of each rope going to different sides of the ship; this gives two eyes over the mast instead of four, and makes everything depend on the strength of the seizings. It is now a very common practice to cross the top-gallant rigging and set it up on opposite sides of the top, instead of reeving it through the necklace on the top-mast and setting it up on the same side. This is done entirely for the sake of saving seconds in shifting the spars, either the top-gallant-mast or the top-mast. Shrouds so treated give no support to the mast whatever; probably they act in the reverse way, as may be easily shown by drawing a straight line to represent the masts when standing upright and lines in rough proportion at right angles for the top and cross-trees. Draw the top-gallant rigging on one side from mast to cross-tree, and thence to the opposite side of the top. The top-mast, having a little play in the cap and at the heel, is bound to go over some inches at the head, taking the cross-tree with it; it will then be seen that the weather side of the cross-tree has approached the lee side of the top, slacking the weather and tightening the lee top-gallant rigging.

Getting a lower yard on board requires great care to avoid injury to the hammock netting and other things. Spars should be slung over the side for it to rub against and slip-ropes through the ports to ease it over the gunnel. If it is to be hoisted in on the port-side, the starboard yard-arm is towed foremost. A hawser may be rove through the port top-block down through the lubber's hole and bent round the centre of the yard. The hatch of the lubber's hole must be open and a strong mat provided. Instead of the hawser the jeers may be partially rove, the standing part being secured to the yard, and also the sail-tackle from the top-mast-head to the lower yard-arm and the starboard up-and-down tackle to the starboard yard-arm, also a burton from the fore-mast to the main-yard, or from the bowsprit if it is a fore-yard. The capstan and jeers will heave up the bulk of the weight, while the other tackles cant it and ease it across the gunnel. A derrick is sometimes used to keep it off the ship's side. When a ship is alongside a jetty, a guy from a strong-hold on shore removes all difficulty, and a list towards the side at which the yard is coming in is desirable. Lower yards are usually rigged while resting with strong gunnel; they are swayed up by the jeers, and slung with strong chains—the part round the yard being connected with that round the lower mast-head by a tongue and slip. The yards must be

prevented from canting forward with the weight and drag of the sail; accordingly the slings, either chain or rope, should be put on with the bight coming up the fore side (see fig. 18, where the arrow indicates the fore side and the direction the sail pulls); they are generally put on the wrong way. Merchant ships are invariably fitted with iron trusses, which are fixtures on the mast, holding the yard at the requisite distance and acting as a universal joint. They are of great advantage where there is not a large crew.

While the rigging is progressing the disposition of all heavy weights is worthy of serious attention; for not only ought the vessel to be brought to the draught and trim designed by the builder, or that which has by experience been found the best, but there must not be too much strain at any one part, especially the extremities. In ships intended for sailing or steaming rapidly this is of vital importance; the bows and sterns of cutter or schooner yachts should be empty. Placing the weights in the wings of the hold will steady the rolling motion and make the intervals longer; but this may be carried too far for stability, especially if the vessel has a low free-board. Weights low down close to the keel will increase stability at the expense of a quick uneasy jerking motion. A yacht which carries much ballast low down will be very stiff under canvas and may sail well in the Solent, but would be unfit to go outside the Isle of Wight. When heavy weights are carried in merchant ships as part cargo, they should never be placed as a solid mass; railway bars, for instance, may be stowed gridiron fashion a foot apart, by which means they will occupy as much space and act upon the ship in the same way as an equal weight of provision casks.

Before bending sails all the ropes are rove ready for use. A yacht's sails if new should be scrubbed, to take the stiffness out of them. In all cases they should be set when bent and the yards braced each way (unless it is blowing too hard), or there is a risk of something going wrong when they are required for use. In setting them care should be taken that no part is stretched or girt unduly.

The inner end of a chain cable is usually secured by a tongue-slip and by a short piece of cable which passes round the mast or is shackled to the keelson; it still retains the name of "clinch." The tongue should not have scope enough to reach the compressor, as it has been known to strip back the ring and slip the cable. It is a good thing to trice up the slip before the cable is stowed, so that it will be accessible at all times, either for slipping, shackling another cable, or bending a hawser. It may be thought that a chain cable would run into the locker and stow itself, but that is a mistake; if care is not taken to spread it evenly, it will form a pyramid with turns round the base, upon which the upper part will fall as soon as the ship leans over; it will then be necessary to haul up several small bights before the cable will run clear.

A ship should never lie long at single anchor in a tide-way or during variable winds, for fear of fouling her anchor and thereby destroying its holding power. Frequently space is wanted, as ship and cable range over a large circle, with liability to foul other ships or their anchors. A long scope of cable will only keep a ship clear of her anchor during very light winds, unless assisted by close attention and correct judgment on the part of the seaman. The direction of the two streams of tide should be considered in connexion with the wind in order to keep the ship to leeward of her anchor each time she passes it. A strong wind blowing across the direction of the tide and acting on the hull of the ship will secure that effect; but, when the directions of wind and tide are the same or nearly so, precaution is necessary at each turn of the tide; it is then that a buoy watching over the anchor is of great service. When the wind and tide are in the same direction the helm should be kept over to that side which will cause the ship's head to point in the direction on which she has previously passed the anchor, as the fight of the cable will be dragging that way. The force of the tide alone will cause her to shoot over considerably; but when she is assisted by the fore-top-mast stay-sail (or stay-fore-sail in a small vessel) the sheer will be much greater. The sheet in either case is better to windward and the fore-top-sail braced sharp abox if the wind is light; but, when the tide commences to change, the sail should be allowed to fill, or it should be taken in and the helm placed in midships. If sufficient effect has not been produced by helm and head-sails before the tide ends, the mizzen-top-sail should be set as soon as the ship falls head to wind, first braced abox to turn her stern in the desired direction and then flat aback so as to drag the cable straight. Cutters and schooners have not that advantage; they must depend on the helm and head-sails. At the end of a weather tide the helm and stay-sail will guide the vessel past the anchor. If a ship should break her sheer (pass the wrong way), or during calms and variable winds should approach her anchor, the cable should be hove in, and if there is reason to suspect the clearness of the anchor it should be sighted, since it will be of no use as an anchor if a turn of cable is round the fluke. When anchoring, the state of the tide must be considered in connexion with the depth of water; a vessel was once left high-and-dry by the ebb-tide near Dungeness, and a large iron ship drove her own anchor through her bottom in the Solent, off Lymington.

The avoidance of the anchors in shallow water is another reason for mooring.

When a ship is in an exposed position, where it may become necessary to let go two or three anchors through stress of weather, in any part of the northern hemisphere, the bower on the port side should be used first, next the foremost one on the starboard side, and as a third the after one on the starboard side, since the ordinary wind veers with the sun, and at the end of the gale the cables will be clear of each other. In the southern hemisphere the reverse order holds good.

When a ship is likely to remain many days at an anchorage where there is a tide or variable winds it is better to moor at once on arrival, with a scope of cable each way six or eight times greater than the depth of water, and an open hawse towards the worst wind. The two cables combined should always be much in excess of the distance between the anchors, otherwise they will possess but little strength to resist a rectangular strain,—an error frequently committed. The amount of support which cables will render under such circumstances will be in proportion to the sine of the angle contained between the anchor and the ship's bow and a line from one anchor to the other. Suppose, for example, a ship moored with anchors east and west of each other, 100 fathoms apart and having 55 fathoms on each cable, in 10 fathoms of water. With chain cables the hawse pipes would not be more than 53 fathoms from each anchor, consequently with a south wind the support given to the ship by each cable will only be 33 per cent. of the strain on the cable,—that is, say, 66 tons combined when the cables are strained up to 100 tons each. The support increases rapidly as the cable is veered; an addition of 5 fathoms each way will (under the above circumstances) give 101 tons, and a scope of 80 fathoms each way will give 153 tons. In practice the cables by dragging over the ground, especially soft mud, assume a direction more ahead, particularly when each cable has a long scope. The anchors should be placed sufficiently far apart to prevent fouling with the slack chain, but not farther, unless the water is too shallow to allow the ship to pass over her anchor at low tide. Such an anchorage is not suitable for very long ships unless special moorings are provided, for which purpose Parks's mooring-blocks are very suitable and inexpensive; they are commonly used in Portsmouth harbour. These blocks are recommended as moorings for the use of yachts and small craft, as being trustworthy and less likely to be stolen than anchors of any kind. Should a ship that is moored with a good scope on each cable have the misfortune to part one of them, her position will be preferable to what it would be if parted from a single anchor, as the bight of cable dragging over the ground will retard her progress, giving more time for another anchor to be let go. In all cases of veering cable either it should be done so freely that the ship will fall off broadside to the wind, when it may be secured while drifting, or it should be done very slowly, a few fathoms, or even a few feet at a time, the ship not being allowed to get any stern way. Veering during a squall should be avoided, if possible; it should be done in time, before the violence of the squall is felt; but, if it is intended to pay out freely till broadside on, the head-yards should be braced abox to assist and another anchor should be ready. A cable should never be secured entirely by the bits or windlass, but the compressor and deck stoppers should participate in the strain. When unmooring, the riding cable should be veered freely to allow the ship to get directly over the lee anchor; if it is embedded, stopper the cable while vertical and heave on the other, which must break it out.

The laborious operation of clearing hawse was mitigated or avoided by the introduction of chain cables and the invention of the mooring swivel. As the cables unshackle at every 12½ or 15 fathoms, the end to be dipped round the other cable need not be long. There are two general methods of holding the weight of the lee cable while the turns are taken out. The simplest is to have a light tongue slip to take the flat link, but only about one-tenth the strength of the cable; in a large ship it should have a roller at the top, so that the end of a hawser may be rove and form a standing part. The slip being fixed on the lee cable close above the turns and the hawser taut, the nearest shackle inboard is taken out, and the short end thus formed is hauled out of the hawse-pipe by the fore-bowline, or else by a rope from the bees of the bowsprit, a hook-rope being also attached for hauling it inboard again. A boat should be in attendance from which to detach the hook-rope from the end of the cable, pass it round the riding-cable, and make it fast again to the end of the cable (hanging by the bowline) for hauling it back through the hawse-pipe; thus an elbow is formed taut round the riding-cable in the reverse direction to the elbows and turns below the slip. That operation must be repeated till the same number of turns is formed above as below the slip,—observing that a cross cannot be removed, but the lee cable can be brought under the other. When the cable is taut in and shackled, the slip is knocked off, which allows the turns to drop clear. The cables will then be as they were when moored, with the addition of one or two fathoms on the lee cable. If the short end of the cable is lowered into a boat and lifted by the bowline only for each turn,

The operation can be performed much quicker. The second method is to lash the two cables together above the turns with a piece of old rope, which acts as the slip and is cut when done with. In rough weather when a boat cannot lie under the bows the lashing must be passed by a man on the cable (if it is not high enough, heave it up), after which both cables are hove into the same hawse-pipe, whence they are easily cleared inboard; if there are many turns a small lashing will suffice in moderately deep water.

One of the objections made to slack mooring is that turns are formed below water where they are not visible. To meet this objection a piece of paper representing a ship stuck to the glass cover of a compass, with two differently coloured threads attached to paper anchors or inserted into cuts at the edge of the card, in the directions the anchors actually bear from each other, will represent all the turns which the ship makes with the cables.

There are various ways of putting on a mooring-swivel, but doing it inboard appears to be the safest and easiest. First place it in the riding-cable by shackling the two short legs of the swivel; leave the two linked ends for the second cable, the end of which being hauled out of the hawse by the bowline is hauled into the other pipe by a hook-rope and shackled to the outer long leg; the stopper just inside the hawse (which had been holding the weight outboard of the lee cable) is then slipped and that hawse-pipe is left clear for hauling out the inner end of the lee cable, which is hauled in the other side and shackled to the inner (upper) long leg of the swivel; it then becomes a bridle. There are thus three parts of cable in that hawse-pipe; the last, having no weight, should be stopped here and there to the others so as to be carried out as the swivel is veered towards the water's edge and the bridle hove up square. Ships constructed as rams take in both bridles on the same side. A mooring-swivel should always be taken off by first heaving it inboard. If moored very slack, turns may form below the swivel during a calm with still water, but they will disappear with a cross strain; and if the ship is about to get under way the swivel and turns may be hove in together. If it becomes desirable to put on a mooring-swivel when turns are in the cables, let it be put on over them; they will soon shake out. One of the bridles is sometimes taken off the swivel for the sake of clearing that side of the deck; the error is obvious on considering that the strength of the remaining part is not equal to the strain which may come upon the span, and the nip in the hawse-pipe is always the part most severely tried. The importance of frequently white-leading and greasing all cable shackles and swivels is obvious, but, being troublesome, it is much neglected. The bow of a cable shackle should always be forward; if the reverse is the case, the shackle may strike the side of the hawse-pipe or get jammed under the compressor. The shape of a shackle bolt should be such as to prevent it entering the wrong way; they often go half way in and jam.

It is desirable that every vessel should carry anchors as large as she can stow and work conveniently, and cables to correspond. A wooden-stocked anchor is lighter when under water than an iron-stocked one of similar holding power, and the wooden stock is less liable to foul when let go; but the durability of iron has nearly rendered the wooden stock obsolete. The old-fashioned anchor with long shank, fluke, and stock had greater holding power and certainty of grip than the more compact dumpy anchor now in common use. Backing large anchors by smaller ones is now seldom practised, except when vessels are on shore and the anchor is laid out on a sandy bottom; it is generally better that each anchor should have its own cable and proportionate strain. Floating anchors were formerly used to keep ships' bows up in a gale; they were made of iron crossbars and three or four thicknesses of strong canvas, or a spar with a heavily weighted sail, spanned with a stout hawser; such a contrivance might frequently be improvised and used to prevent a boat or small vessel from foundering.

Should an anchor be lost in sand or soft mud after having borne a heavy strain, it may be buried entirely, when it can only be recovered by grappling the chain, if that is of sufficient length. This is best done by a small anchor with a bar of iron to assist the stock and dragged by a long scope of chain. If the anchor is on ordinary ground and only sunk as far as the shank or a little more, as shown in fig. 38, it is easily recovered whether there is any cable on it or not. The full length of a hawser strong enough to weigh the anchor should be used as a sweep, with a boat at each end pulling very slowly or dropping with the tide, in the reverse direction to the strain when it parted, so as to catch the fluke as a hook. Towing a hawser against the tide is generally waste of time, and a chain forms too narrow a bight, unless the anchor is buoyed. When the anchor is felt both boats should close together and their crews pull with all their strength for a minute or two. Then, while one boat remains stationary, keeping her part of the hawser steady, the other should cross her bows with a slack hawser, which thus passes

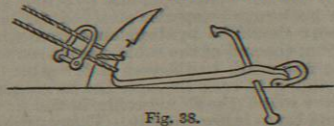


Fig. 38.

under the tauter part; this second boat, by continuing in a circle round the anchor and returning to the side of the stationary one, will cause a turn to be formed round the fluke, as represented in the figure. Both crews should again pull hard to tighten the turn round the fluke, after which, both parts being held in one boat and made equally taut, an anchor shackle (buoyed) is placed round them and shaken down by a veer-and-haul pull on both parts by the crew of one boat, while the other tows ahead to keep a strain on the hawser till it is nearly vertical, when the anchor is secured. The ship can then take in the two parts of the hawser and weigh it.

In getting a ship under way there are a few precautions which should necessarily be observed. If the ship is moored, the first anchor to be weighed is that which it would be least convenient to sail from. At the time of unmooring the direction of the tide is very important in the case of sailing ships, and should not be disregarded by steamers. The hauling part of the cat-fall is always through the foremost sheave, to prevent the tackle from fouling owing to the ship's motion through the water. The cable on the second anchor should always be hove short before making sail. Should there be plenty of room and the wind moderate, there is no caution necessary beyond placing leadmen in the chains with newly marked lines, and putting the helm hard over each way to ensure its being clear. The after-yards should be braced up on one tack and the head-yards on the other, to pay her head off; in cutters and schooners the stay-fore-sail is used for that purpose. If another vessel is at anchor too close astern to ensure gathering way while ahead of her, it should not be attempted; but, by squaring the after-yards as soon as the anchor is tripped, the ship's head will pay off till it becomes safe to fill all the sails and pass under the stern of the other vessel. The anchor should have been *catted* and perhaps *fished* also during the interval; much way should never be on the ship till the anchor is secured, for fear of its slipping or of a man falling overboard. Should rocks or shallow water be inconveniently close astern different means must be adopted. If the wind blows directly on shore, offering no choice of direction, and a current runs parallel to the shore, the ship's head should be cast against the stream. The yards should be braced abox sharp up, with as much sail set over them as the force of the wind will allow, every means being taken to heave the anchor up quickly; and, in a well-manned ship, as soon as it is out of the ground, haul on board the main-tack and aft with the sheet, set jib and spanker. The helm being alee, keep it so as long as it is required, and brace round the head-yards quickly; the ship will soon spring ahead. Then, by keeping close to the wind, the rate of movement will be retarded till the anchor is secured; then set the fore-sail.

The above is applicable in moderate weather when all or nearly all plain sail could be set. But, should there be a strong wind and a rough sea, it might not be possible to weigh the anchor or to prevent it staving the bows if it were hove up; in that case it must be sacrificed for the safety of the ship by passing the strongest hawser from the after-port (padded with mats) to the cable, making it fast by a rolling-hitch, and hauling it taut; an axe and block should be in readiness, also guys, to prevent the spring of the hawser breaking men's legs. The courses should be reefed and all ready for setting; the top-sails (double or treble reefed) should be set or sheeted home ready for setting; and all the yards should be braced up on the tack it is intended to go off on. The first opportunity should be taken when the ship is commencing a yaw in the desired direction to slip the cable, set the fore-stay-sail and fore-top-mast stay-sail; as soon as the top-sails fill, cut the spring, set the reefed courses, and the main- and mizzen-try-sails. To veer the cable previous to slipping would be more likely to break the hawser. The expedient of losing an anchor should only be resorted to when there is too much wind and sea to admit of weighing it and not too much to prevent the ship, of whatever description, from gaining something to windward under a press of sail. Otherwise her condition is made worse by the loss of the anchor; it would be better to decide upon riding the gale out, letting go other anchors, veering all the cable available, striking the top-masts, and bracing the yards nearly fore-and-aft. The cutting away of the lower-masts, when necessary, must always be done with great care to avoid killing people or bilging the ship with the wreckage. The lanyards of the lower rigging on one side should be cut as the ship rolls in that direction, and a few notches made in the mast on both sides 3 or 4 feet above the deck, the men running aft out of the way when it is likely to fall, for which operations they would have from eight to fourteen seconds. As soon as the mast has fallen the lanyards of the stays should be cut and the most strenuous efforts made to cut and clear every rope which would still hold the mast to the ship.

When weighing in rough weather with sufficient room to drift, it is better to have the anchor fully secured before making any sail; or, if it is intended to run before the wind, the ship can be kept on her course by the jib only till the anchor is stowed. Steaming up to an anchor against strong wind or tide is objectionable, as it requires great attention and judgment to avoid jerks; the same applies to steaming in a gale to ease the strain on the cable; a con-

stant watch should be kept to prevent the cable ever becoming slack. Fore-and-aft rigged vessels have much less difficulty in getting under way when close to a lee shore, as their main-sails can be fully set without holding wind, and directly she pays off all the sails draw.

If the anchors drag and the ship strikes the bottom, especially on rocks, and it is apprehended that she may go to pieces or founder in comparatively deep water, it would be right to select the best place on shore (if there be a choice), and endeavour to thrust her into it by slipping or breaking all the cables and making sail, if there is still the means of doing so, with the view of driving her up as high as possible and so saving life; let it also be at the top of high water, if that can be waited for. When there is a heavy strain on a chain cable it is easily broken by scratching a notch with a common saw on a link that rests firmly on the bitts and then striking it with a maul or sledge-hammer.

The usual way of testing whether the anchors are holding or not is by dropping the lead over the side and leaving the line slack; but the ship is liable to swing over it, causing it to be disturbed. A grapple over the bow or from the bowsprit is preferable. Also by sitting on a cable before the bitts a tremulous motion is felt if the anchor is dragging.

If instead of a dead lee shore we have the wind oblique with the line of coast, and the ship from some cause too close to admit of a stern-board towards it, the head-yards should be braced abox to cast her head inshore, while the after-yards are kept square; this will cause the ship to make a long stern-board from the shore, which will not terminate till the wind is well abaft the beam. The helm up to that time may be kept in midships, as there is no reason to diminish the curve. As the stern-way is lost the helm should be put hard up, the head-yards squared, and the mizzen-top-sail kept shivering till braced up on the desired tack. The main-top-sail should be kept full. If it is necessary to get the ship round as quickly and as shortly as possible, the fore-yard, instead of being squared when about to shake, may be braced entirely round quickly so as to continue paying her bow off till the wind comes aft, then squared to allow her to come to. The jib or the fore-top-mast stay-sail (according to the weather) may be hoisted when the anchor is tripped or not, until the wind is before the beam on the desired tack; if at the former time the sheets should be hauled to windward and kept so till the ship is before the wind, then eased off till the wind comes before the beam. The spanker or mizzen-try-sail should be set as soon as it will draw the right way.

What has been said about trimming the sails as the ship is turned round after casting with her head inshore is equally applicable to a case of ordinary wearing when it is desirable to turn the ship with as little loss of ground as possible. As a general guide to the position in which the yards should be placed, it may be remembered that the pressure on the sails always acts at right angles to the yards. This may be exemplified by bracing the yards sharp up when the wind is two or three points abaft the beam. As it will then blow directly into the sails they will certainly receive greater strain, but the speed of the ship will be less than when the yards were square; and it may be observed that considerable leeway will be caused by the lateral pressure. In wearing ship all the fore-and-aft sails should be taken in except the head-sails, and when the helm is put up the main-sail should be taken in and the mizzen-top-sail shivered,—the latter continued till it is sharp up for the new tack. A fashion has been adopted of leaving the mizzen-top-sail square till after the head-yards have been squared; hence everything depends for a time upon the action of the rudder, and the ship sails a considerable distance before the wind and loses so much ground. The operation of wearing a cutter requires much more care than with a square-rigged vessel on account of the heavy boom. A schooner is treated similarly, but the spars and sails are lighter in proportion to the size of the vessel. Before putting the helm up, the tack of the main-sail is triced up (the top-sail clewed up), and the peak dropped till it is nearly in a line with the boom topping-lifts, which is called scandalizing the main-sail. Both peak and boom are secured firmly in midships by means of the downhaul and sheets. Not only is the diminution of after-sail necessary to allow the vessel to pay off quickly, but the change of wind from one quarter to the other will only cause a gybe which is perfectly under control. The jib and stay-fore-sail are gybed by hauling the sheets flat just before the wind is aft so as to diminish the jerk as much as possible. The peak of the main-sail is easily rehoisted while the tack is up, and the vessel luffed up to the wind. The runners and weather-boom topping-lift should be pulled up while the ship is before the wind and the top-sail-sheet hauled out as soon as the peak is up,—the tack-tackle being shifted to windward and pulled down. In wearing during fine weather, especially in yachts when racing, some risk may be preferable to the loss of time and the main-sail may be kept set. As the main-sheet is usually rove through a treble block on the boom, a double block to move along the horse, and a single block on each quarter, a strong crew can man each part at the same time and haul the boom in

midships quickly, belaying the part which was at the lee side and is about to become the weather side directly the boom is over the leading block, while the other part is kept in hand till the gybe has been effected to lessen the jerk.

The sails of all vessels are most effective when set as nearly flat as practicable, and also each sail, as well as each part of a sail, should be spread at the same angle from the keel. If under that condition too much or too little weather-helm is required, the balance should be established by changing the quantity of canvas at either end or by altering the trim, not by permanently easing off a sheet, for that is as detrimental as dragging the rudder at a large angle. By altering the stand of the masts materially the angle and consequent set of all gaff-sails are thrown out.

To tack a fore-and-aft-rigged vessel is very simple; by easing off the jib and fore-sheets at the time the helm is eased down and hauling over the main-sheet, the vessel will soon run up to the wind; then if the fore-sheet is hauled flat over as for the former tack it will assist to pay her bow off the right way. The jib-sheet would be hauled aft while shaking, but not too soon to cause it to take the wrong way. The fore-sheet is shifted over as the other sails are about to fill, according to the speed with which the vessel is paying off. In a smart vessel, such as a cutter-yacht in smooth water and with a good breeze, there will be no occasion to retain the fore-sheet, but allow it to shake itself over similarly to the jib. Returning to the idea of tacking with difficulty,—the helm should be put hard over as the speed decreases and reversed directly stern-way commences; this remark applies to vessels of all shapes and sizes, as will also the advice not to put the helm over to a large angle while the vessel is going at great speed. At an angle of 10 degrees, more than 98 per cent. of the force on the rudder is applied to turning the vessel and 17½ per cent. to retard her; while at 30 degrees one-half the force would retard and 86½ per cent. tend to turn. Hence we see the reasons for recommending close fitting, broad, tapering rudders.

While the vessel is in stays the weather-boom topping-lift should be pulled to take the weight of the boom, the runner-and-tackle on the weather side set up, and the lee one slacked as soon as she is round; also shift the main tack-tackle over to windward and set it up; get a pull of the gaff-top-sail tack if necessary.

The jib of a cutter, yawl, or schooner with a running bowsprit is a difficult sail to handle when the vessel is under way. If there is sea-room it is better to keep the yacht away before the wind and let go the outhaul, when the traveller will run in, or pull at the same time on the inhaul, which should be fitted with a span to keep it square. Haul the stay-fore-sail sheet over to make room to haul in the jib to leeward of it. Gather in the slack canvas smartly to keep it from getting overboard; get hold of the luff of the sail by the stay-rope, while some hands pull on the downhaul. When the sail is perfectly under control let go the halyards and continue hauling on the stay-rope and downhaul. When there is not room to run before the wind, it is best to heave to with fore-sheet to windward while taking in or shifting a jib; by letting go the outhaul the traveller will run in and the sail can be handled as before, a good hold being always kept of the weather side, that is, the luff of the sail. If another jib is to be bent it should be laid along the weather side of the deck in readiness, with the tack forward and the head aft. The sheets are then untoggled from the former sail, handed across outside (to windward) of the fore-stay, and toggled to the second jib; also take the tack to the traveller, hook it, and run it out. Hook the halyards and hoist the jib up by them; then tauten the luff by the purchase while the sheet is flowing.

A jib-headed gaff-top-sail is preferable for use on a wind and commanding breeze, though for light winds a long yard spreads a fine sheet of canvas. Such a yard should be slung at one-third from the fore-end (as a boat's dipping lug), the clew-line block secured at the length of the leech from the upper end, and the standing part of the clew-line made fast to the lower end,—this last to keep it clear of the cross-tree when being hauled down, which must always be done on the side it has been set, a tack being made if necessary to bring it to windward. On the approach of a squall the fore-sail should be hauled down by means of the downhaul and the vessel luffed up; it is dangerous to attempt bearing up at such a time until the main-sail has been scandalized; the effect of the water on the rudder aids greatly in tripping a vessel over.

As bad weather comes on the main-sail must be reefed (a smaller jib having been already set) by topping up the boom, easing down the peak and throat, and hauling down the reef cringle to the boom by the reef-tackle; lash the tack and tie the points without rolling the slack canvas. The second and third reefs are taken in as the wind increases and the fore-sail reefed again or stowed, during which time the jib-sheet should be hauled flat, the main-tack triced up, and the vessel kept close to the wind to avoid plunging the sea over the bow. To reef the bowsprit,—hoist the top-mast, let the jib run in, slack the bobstays and bowsprit shrouds, take out the fid, and let the bowsprit run in one or two reefs; then reef it, set taut the gear, and set a small jib. It is at all times much more

difficult to steer a short vessel than a long one, but especially in a heavy sea, when the mode of treatment must be entirely different. A small vessel should be luffed up to meet every large wave in order to bow it as much as possible. She will have but little way on at the time of meeting it and will drop into it easily; the bow will then fall off, the sails fill, and a run be made parallel to the waves till she is luffed up again. A four-oared gig has been taken through a heavy sea under oars by pulling up to meet every dangerous crest which could not be dodged, and just before it broke over the bow backing away from it. The smallest amount of sail which can be shown by a main-sail is when it is balance-reefed; this is accomplished by close-reefing it and lowering the jaws of the gaff close down to the boom, while the peak stretches up that part of the leech above the close-reef cringle. The plan is more frequently adopted by fishing smacks than by yachts or other well-found vessels; they have a try-sail which, being laced on a smaller gaff, is hoisted by the same peak and throat halyards as the larger sail, and has its sheet secured to a bolt near the stern, while the boom is crutched and secured with the main-sail and the large gaff lashed to it. The try-sail admits of being reefed; it is a safe sail either on or off the wind in rough weather. The greatest care is necessary when running before the wind to keep the vessel on her course and to avoid gybing. A vessel should never get under way without a small boat, and a cutter should never be without her legs for fear of taking the ground unexpectedly. In racing to windward, if the wind is variable, keep nearly dead to leeward of the mark vessel, as every change in the direction of the wind will then be an advantage; unless there is a tidal preference for one direction over the other, that will of course decide it.

If taken aback by a change of wind, and wishing to remain on the same tack, put the helm up and haul over the fore-sheet. In a ship haul over the head-sheets and brace the head-yards abox. The way to tack a ship under favourable circumstances may here be assumed as well known, and only a few hints relative to doubtful cases given. A few minutes prior to the attempt set all suitable sail, keep steadily "rap-full" with a small helm, so as to get as much way as possible. If the crew is large enough to list the ship, send them over to leeward, ease down the helm slowly, haul the boom in midships, haul down the head-sails, ease off the fore-sheet, let go the head-bowlines, and check the head-braces. Directly the wind is out of the fore-top-sail, brace the head-yards sharp up again and haul the bowlines. When the wind is entirely out of the main-top-sail, let go the top-gallant bowlines (if those sails are set) and raise tacks and sheets, except the fore-tack, which should be raised after the main-yard has been swung. As soon as the vessel loses her way, shift the helm hard over, and send the men to their stations. If she brings the wind across her bow, hoist the head-sails with the sheets on the same side as before; if the wind takes them well and the ship is still going round, give the order "main-sail haul," haul down the main-tack, aft the sheet, shift over the head-sails, haul the after-bowlines. As the main-top-sail fills, or before, according to the rapidity with which she pays off, swing the head-yards to the order of "haul off all."

If when near head to wind it is found that the bow is falling back and stern-way commencing, it is evident that she has "missed stays." The helm in that case should not be shifted, as with stern-way it will help her to pay her bow off in the direction it was before. The head-sails should be hoisted, the main-sail and spanker taken in, the fore-sheet hauled aft, the after-yards squared. As the wind comes abaft the beam the mizzen-top-sail should be kept shivering and the main-top-sail just full; shift the helm as she gathers headway. When before the wind square the head-yards, shift over the head-sheets, and keep them flowing. Set the spanker when it will take the right way; complete wearing as before described. This is similar to "box-hauling"; it is not necessary to brace the head-yards abox if she will fall off without. The manoeuvre of putting the helm down and letting the ship shoot up in the wind before wearing is sometimes adopted for the sake of diminishing the run to leeward. Hauling all the yards at once is very objectionable; the sails are longer aback and have to be hauled round by main strength against the pressure of the wind.

"Club-hauling" may occasionally save a ship even in these days of steam, as a paddle-steamer will not turn with her head against a strong gale and a heavy sea, nor will a sailing-ship with an auxiliary screw-propeller. It may be done when the ship is found edging down on a lee shore, too close to wear, and having a depth of water not exceeding 20 fathoms. It will take two or three minutes to open the hawse-pipe, get the cable clear, and procure hammer and punches for unshackling, and mauls for breaking the cable if necessary. Put the helm down and act as in ordinary tacking till she ceases to turn nearer to the wind; then let go the anchor, whether she has entirely lost her way or not, as passing the anchor a little will give a greater swing back when the strain comes and allow more time for slipping the cable, which should be done directly the wind has crossed the bow; at the same time swing the after-yards. If the cable has been slipped successfully, the head-yards may be hauled as soon as the after-yards have been braced up, as

she will soon be broadside on. It has been proposed to run a spring from the after-lee-port to the anchor, but that would take too much time.

"Backing and filling" is practised in a tidal channel which is too narrow to allow a ship to gather way for tacking. One top-sail, with the jib and spanker occasionally, is generally sufficient to give slight head or stern way, to avoid either bank or another vessel, while the tide carries her broadside against the wind; the less sail exposed the less the lee-way. Fore-and-aft vessels having less power to get stern-way should have a boat in attendance with a line and a small anchor.

"Kedging" was a frequent performance before steam-tugs were introduced; it consisted of a series of movements from one small anchor to another, previously laid out by boats. For a similar purpose harbours that were much frequented were formerly furnished with a succession of warping buoys. The large ropes used for transporting ships are called hawsers, and by a strange anomaly were formerly cable-laid nine-stranded. Such rope is hard and stiff to handle; it absorbs more wet and retains it longer, therefore is less durable; when new the strength is far inferior to hawser-laid rope of similar size. Manila and coir hawsers float on the water and are therefore very useful.

Dropping through a narrow tidal channel by means of an anchor just touching the bottom is called "dredging" or clubbing; it can be practised in a passage which is too narrow for backing and filling, such as the upper part of the Thames, where it is done every day. The vessel swings to her anchor and points her stern up (or down) the stream; by heaving in the cable (for which the steam capstans and windlasses afford great facility) the tide takes the ship on as fast as it is running so long as the course remains clear. When it is desirable to approach either side, a few fathoms of cable paid out will cause it to hold; the helm and the action of the tide will then sheer the ship as desired, and by heaving in cable she will go on again, so that a sailing-ship should go up at half the rate of the tide at least. With a screw-steamer it is far easier, as the screw will straighten her as well as the tide, and when fairly pointed through an open space she can make a stern-board at five knots an hour while perfectly under control.

A few words may be said about making and shortening sail in bad weather. One point holds good in all cases: the sails should never be allowed to flap, as that exposes them to the danger of splitting. The tack or luff is invariably secured first, while the sheet bears a steady strain enough to keep the sail from shaking. Before hoisting fore-and-aft sails the sheets are steadied aft; and should a sheet carry away, the sail is hauled down or brailled up instantly. Spankers and try-sails should be taken in entirely by the lee-brails, the stack only of the weather-brails being at first taken down. A practice has become general in the British navy of securing the top-sail clew-line blocks to the lower cap instead of round the yard, for the sake of saving time when shifting top-sails; the use of the clew-lines for hauling the yard down and steady-ing it is thus lost; this is one of many objectionable practices.

There has been a difference of opinion as to the mode of setting and taking in top-sails and courses; but the same rule should apply to all square sails alike: that which is safest for one will be safest for the others. Experience and the balance of opinion favour the hauling home of the weather top-gallant-sheet, top-sail-sheet, and tack of the fore-sail or main-sail first, with a good strain on the clew-lines, clew-garnets, and bunt-lines, to avoid flapping. The lee sheet may then be hauled and eased down by clew-line and bunt-line. Each bowline should also be steadied taut in succession to prevent the leech from flapping. There appears to be no advantage in first hauling the lee-sheet partially down. The taking in of these sails has been equally a matter of dispute, and many advocate taking in a top-sail in a different manner from that which they would adopt in taking in a course. Falconer's rule was often quoted and followed in former times. It runs thus—

"And he who strives the tempest to disarm,
Will never first embarrail the lee yard-arm."

It must be remembered that the decision there supported by the sea-poet was then a novelty, and opposed to the opinion of the practical seaman. A main-sail had been split by "letting fly" the sheet; but that proves nothing, as all sails will split if the clew flies loose in a gale. The lee clew of an eighty-gun ship's main-top-sail was blown over the yard-arm in consequence of the weather-sheet having carried away; that clew was hauled up first. It might not have happened had the bunt-lines been well manned and had there been a small strain on the lee bowline. Either plan will answer if the bunt-lines are well manned and the sheets eased steadily; but that the weather clew should be set first and taken in last is preferable.

In taking in top-gallant-sails before the wind both sheets should be kept fast till the yard is down. When a top-sail is to be reefed the yard should be pointed to the wind; and for the first reef the top-gallant-sheets, bunt-line, and bowlines should be hauled taut; for the second reef the top-gallant-sail should be clewed up, to keep the sheets from knocking the men at the yard-arms. In rough

weather a preventer parrel and rolling-tackle should be put on before the men go on the yards. For a fourth reef the top-sail should be clewed up during the operation; it will then be performed with less difficulty. The long reef-points in top-sails and courses have generally given place to the lighter and more expeditious method of having reef-lines on the sails, with becketts and toggles on the jackstay. The whole strain of the sail is thus thrown on the jackstay and small eyebolts, instead of the points being firmly tied round the yard itself. Also the slab of each reef is usually allowed to hang down and chafe at the fold; but this can be prevented by fastening three or four small slab-lines on each side of each reef. Cunningham's invention for reefing top-sails is very valuable in all weakly manned ships, but it requires to be kept square upon the yard while rolling up. If it becomes necessary to shift a top-sail during a gale, it should be made up on deck in the shape it would assume if furled on the yard, and stopped with spun-yarn, with the reef-earings and bowline bridles showing near the ends and the clews and bunt-line toggles near the centre, where it would be slung by a slip stop. When the two earings are taken into the centre it will form four parts, and the weather top-mast studding-sail halyards being bent round it will cause it to look like a large bale. In that state it is hoisted into the top by the sail tackle, at the same time being steadied by the studding-sail halyards; there all the ropes are bent, clew-lines and bunt-lines hauled up, reef-tackles hauled out, and the sail bent to the yard before the stops are slipped or cut; then it is reefed as desired before the weather sheet is hauled home. A fore-sail or main-sail is bent in a similar manner, except that the various ropes employed on a course are bent on deck, by which ropes and the burtons it is swayed up. Studding-sails are very useful in long voyages; their disuse on the main-mast is to be regretted, especially in long ships. A top-mast or top-gallant studding-sail is shifted "before all," by a man on the yard gathering in the sail as it is lowered to him and holding the outer leech till it cants the right way.

Coasting.

During a coasting voyage the vessel must be within a moderate distance of the shore, therefore the person in charge should constantly be ready to run for shelter when necessary, and have the moral courage to do it in time. In yachting voyages, however distant, there is a natural desire to see the land and all that is worth seeing, and, being well provided with charts, such vessels can enter any harbour, when perhaps a pilot is not able to get out. A ship starting on a foreign voyage should seek "blue water" as soon as possible, and keep a safe distance from all land which is liable to become a lee shore, and not be tempted to edge in because a certain tack is much nearer to the desired course than the other. For the choice of track and for trade winds, see NAVIGATION.

Heaving to.

To heave to for the purpose of stopping is done in a cutter by easing off the jib-sheet, hauling over the weather fore-sheet, and tricing up the tack of the main-sail. A schooner is treated similarly; the top-sail (if she has one) is backed and the gaff-fore-sail is taken in. A ship has her courses hauled up, head-sheets eased off, and either the main or fore yard squared. Upon the latter point opinions differ. If two ships are close together, the one to windward had better back the main-top-sail and the ship to leeward the fore-top-sail; they should always preserve a little headway. Boats invariably board ships on the lee side; small vessels, when drifting fast, on the weather side. A ship at anchor in a tide-way will always present a lee side during some period; but a "weather tide" causes a dangerous sea for boats. A boat's oars should never be tossed up or forward when there is danger of their fouling, for fear of staving the boat or injuring some one in the after part.

When in the vicinity of a lee beach and landing by means of a boat is determined on, the oars should be manned to the utmost and the waves watched (as they always vary), and the boat forced in on the top of the third large wave, care being taken to keep her exactly end on to the sea. At the instant of touching the ground every man should jump out and begin to haul up the boat, if she is of reasonable weight; the next wave will probably put them all out of danger. By holding on to the boat they give and receive mutual support, and avoid being sucked back by the receding water or crushed by the boat.

The term "hove to" as applied to a vessel in a gale of wind is derived from the desire to turn her bow up towards the wind and sea; this under all circumstances of sail should be the point aimed at, since then the seas strike the side obliquely and also the bow, which is the strongest part. The best sails to keep on a ship during a violent gale are the close-reefed main-top-sail, main- and mizzen-try-sails, and fore-stay-sail. The fore-try-sail also may do good, and is far preferable to a main-stay-sail. The pressure of the main-top-sail tends greatly to mitigate the violent motion; also by heeling the ship she presents a higher side to keep the sea out and a sloping deck to aid the water in running off. The helm should be about one turn "a-lee," never hard down. When north of the equator ships should heave to on the starboard tack, and the reverse in southern latitudes. More sail should be made as soon as the gale moderates, to steady the ship. The violent rolling motion may sometimes be diminished by altering course, so that the period be-

tween the waves reaching the vessel may be made to disagree with her own period of oscillation, or when running before the wind by bracing the yards up in opposite directions. Steamers at a reduced speed can scarcely be considered as-hove to; their masts and sails are too weak to be of any use in a gale and too small in moderate winds; they make the rudder do all the work. The best sail to send under is close-reefed main-top-sail, reefed fore-sail, and fore-top-mast stay-sail.

Three contingencies should always be anticipated by the captain and officer of the watch, and in some degree by every man in the crew, so that the alarm should lose half its dread and be met by prompt action,—a man falling overboard, fire, and collision. A boat's crew should be appointed in each watch, who on going on deck should see the boat ready and the plug in. If the ship be on a wind and capable of tacking, on the cry "A man overboard!" the helm should be put down and the ship steered round on the other tack, with either the fore or main yards left square and the courses up; she will then drift down towards the man, while the boat, which was at first on the weather side, is being lowered to pick him up. If the ship is running free the case is worse; she must be brought to the wind instantly with the head-yards square. Various plans have been devised for lowering boats, many of them very good when executed by trustworthy men; the same may be said of the old system with plain blocks and tackles; practice and coolness will render either successful.

With regard to fire, prevention is better than cure; lights in the

hold should never be without a protecting lantern, and passengers' sleeping-cabins should be lighted by lamps fixed in the bulkhead, inaccessible from the inside. Pumps and engines for extinguishing fire should be on the upper deck, for fear of being cut off by the first outbreak. Fire stations and exercise should be frequent ever with the smallest crew. On the first alarm all ports and ventilators should be closed, wind-sails hauled up, hatchways closed as much as practicable, awnings and all lower sails taken in, and the ship kept before the wind, unless the fire is in the after-part, in which case the boats should be lowered at once. Many other things will present themselves to a cool head; perhaps the first order should be "Silence!"

Collisions may be reckoned among those dangers against which

no man can guard himself, be he ever so wise and experienced; it avails not that one ship should do what is right, unless they both do so. The laws upon the subject appear to be all that can be desired (see "Rules of the Road," under NAVIGATION, vol. xvii. p. 277); but the mode of enforcing obedience is very lax and lenient. A purely nautical tribunal is greatly needed, and every unjustifiable deviation should be severely punished, whether followed by an accident or not. It is admitted that in most cases of collision the evidence is so conflicting that a judge must be puzzled where to find the truth. The great increase of speed diminishes the time of approach; the increased length of vessels demands a larger circle to turn in; the want of sail at the extremities diminishes the power of turning, throwing all the work on the rudder, which is proportionately much smaller than it was. The perpendicular stem gives a deadly blow at the flat side, instead of first cutting down the upper works by the sloping cut-water, and probably coming to a state of rest before reaching the water's edge. Sufficient care is not taken to keep all lights from the upper deck and all places where they may disable the eyes of the officer in charge or the lookout men. Even holes have been made at the back of the bow-light box to enable the officer of the watch to see them burning; of course his eyes are thereby rendered unserviceable for seeing distant objects. Officers in the merchant service are invariably in two watches, which does not allow them sufficient time for sleep, especially in windy weather. If immediate action is not taken the instant a sail or a light is reported, the officer in charge should take bearings by the compass, by which he will soon know if the other vessel is inclined to pass ahead or astern. If it remains stationary by the compass, they must both be converging on the same spot.

If a ship should spring a leak at sea which may be attributable to straining and is sufficiently serious, she should be run before the wind and sea under small sail. If the pumps then clear out the water, she may run for a port or resume her voyage when the gale ceases. If the leak does not abate, though the motion of the ship is easy, it will be evident that a butt (end of a plank) has started if it is a wooden ship, or that a plate has given way if an iron ship. In that case, two stout hauling-lines should be placed under the bowsprit and head-gear, and the end of one secured to the head-earring, the other to the clew of a spare top-sail or course, also two similar ropes to the other side, each of the four ropes being marked at 10 and 15 fathoms from the sail. Half a hundredweight of iron (shot or furnace bars) should be attached to each clew, the ship's progress completely stopped, the sail thrown overboard and drawn square across the bows; the hauling-lines on the clews being carried aft and kept square by the marks, while the ropes on the head of the sail are veered, the sail is placed like a large patch over the place desired. Should the position of the leak not be discovered, it might be well to place the sail under the main-mast;