ELEMENTS

OF

SEAMANSHIP.

PREPARED AS A TEXT BOOK FOR THE MIDSHIPMEN OF THE C. S. NAVY.

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PREFACE.

The following work on practical Seamanship has been *compiled* from various authorities, arranged as a Text Book, and as much original matter introduced as the subject admitted of.

It was undertaken with great reluctance, owing to the loss of all previous notes on the subject, and a press of official duties; the impossibility of procuring a Text Book for the Midshipmen under my command, however, induced me to attempt it.

It is intended to *precede* the work on HARBOR ROUTINE, and may be regarded as the *development* of PART I. of that book.

Several subjects, as *Clearing Hawse, Mooring, Shifting Spars and Sails,* &c., &c., are not treated of because they had been already fully described in my MS. Seamanship on *Evolutions,* used at the U. S. Naval Academy; should I succeed in recovering a copy of that work, it is my intention to publish it as PART III. of the subject. The three books will, I believe, be found a tolerably complete treatise on Seamanship and an officer's duties.

Not having been able to read the proof sheets of this, I fear that many typographical errors will occur; they will, however, be corrected in the next edition.

U. S. SCHOOL-SHIP PATRICK HENRY,
James River, May, 1864.

DEDICATION.

THIS BOOK

IS

AFFECTIONATELY DEDICATED

TO MY OLD

MESS-MATE, CLASS-MATE AND FRIEND,

LIEUT. J. PEMBROKE JONES,

U. S. NAVY.

CONTENTS.

CHAPTER I.

ROPE.

Most of the Rope used in the Navy is hempen; Rope is, however, also made of hide, cotton and the fibres of the cocoanut tree; the latter is called *Coir Rope*, and as it floats, is most useful for warps.

Hide Rope is used for wheel-ropes, topsail tyes, &c.

Cotton Rope is but little used in the Navy, and is only good for running gear. The size of rope is denoted by its circumference, and its nature by the manner of its fabrication. It is either white or tarred, contains three or more strands, and up to the size of five or six inches, is made up in Coils.

The hemp is first spun into Yarns, each of which is supposed to be equal in strength to bear a weight of 100 pounds.

Yarns are spun up right handed—several of them spun up together form *strands*, and three or four strands laid up together form *Hawser-laid rope.*

Three such three-stranded ropes, laid up together, form *Cable or Water-laid rope.*

Hawser-laid rope is generally right handed. *Cable or Water-laid rope* is always left-handed.

Shroud-laid rope, commonly used for standing rigging, is right-handed, four stranded, hawser-laid rope; made up round a small rope in the heart.

Rope is supplied from 10 to 1¼ inch; below 1¼ inch it is called "small stuff:" such as 24, 21, 18, 15 and 12-thread rattlin-stuff.

We have also 9, 6 and 4-thread stuff, for smaller seizings.

Also 4, 3 and 2-yarn *Spun yarn*, made of refuse hemp, and used for temporary seizing.

Houseline of 3 threads, *Hambro-line* of 4 threads, and *Marline* of 2 threads are superior to Spun Yarn in make.

Signal-halliards stuff is made up of strands that have been laid up in opposite ways, so as to lessen that tendency to taking in turns which is so inconvenient in hoisting flags.

In hawser-laid rope the strength of each yarn is greatest in the smaller sizes. All rope made with 4 strands is proportionably weaker than that which is made with 3.

Yarns, usually two, unlaid, rubbed down, twisted up the reverse way, and then spun up together right-handed, are called *Nettle-stuff*.

Yarns twisted together by hand in short lengths are called *Foxes*.

A yarn untwisted and twisted up the contrary way, is called a *Spanish Fox*.

[*Rope Walks* should be visited by young officers.]

KNOTS—BENDS—HITCHES—SPLICES, &C.

Knotting, splicing, &c., can only be learned *by practice*. Unless illustrated by *plates*, descriptions of the manner of making knots and splices are of very little assistance.

Preparatory to learning how a ship is rigged, the student must be able to perform the following:

Make a figure of eight knot.
" two half hitches.
" a square knot.
" a bowline knot.
" a bowline on the bight.
" a running bowline.
" a rolling bend.
" a fisherman's bend.
" a timber hitch.
" a rolling hitch.
" a studding sail halliard bend.
" a carrick bend.
" a clove hitch.
" a cat's paw.
" a sheet bend.
" a black wall hitch.
" a Turk's head.
" a marline pitch.
" a grommet.
" a selvage strap.
" a warped strap.

Make a pudding for a mast or yard.
To pudding the ring of an anchor.
To point and graft a rope.
To pitch over a ring-bolt.
Put on a flat seizing.
Put on a round seizing.
Put on a throat seizing.
Make a short splice.
Make a long splice.
Make a cut splice.
Make an eye splice.
Make a flemish eye.
Make an artificial eye.
Worm, parcel and serve a rope.
Make a sheep-shank.
Put a strand in a rope.
To wall and crown.
Make a Matthew-Walker knot.
Make a spritsail-sheet knot.
Make a shroud knot.
Make a French shroud knot.
Make a single diamond knot.
Make a double diamond knot.
Make a stopper knot.
Pass a rose lashing.
Whip the end of a rope.
Make common Sennit.
Make French sennit.
Make round sennit.
Make square sennit.
Make a sword mat.
Make a French mat.
Knot a rope-yarn.
Make a marlingspike hitch.
Sling a cask with bale slings.
Sling it head up.
Work a cringle in a rope.
Make an inside clinch.
Make an outside clinch.
Make a set of hammock clews.
Make a hawser bend.

Make sennit for hats.
Bend a buoy-rope.
Strap a buoy.
Rig a Spanish windlass.
Pass a racking seizing.
Pass a figure of eight lashing.
Pass a round lashing.
Show how to take a turn with a rope.
Make a Nipper.
Strap a tail-block.
Strap a block with a single strap and thimble.
Strap a block with a double strap and thimble.
Strap a block, single, with lashing eyes.
Strap a block, double, with lashing eyes.
Strap a block with a hook and thimble.
Strap a block round a thimble on a bar.
Strap a block with a grommet strap.
Turn in a dead eye.
Turn it in cutter-stay fashion.

Questions—Why is Tar put on Rope?

Answer—To preserve it when wet; it, however, weakens the Rope.

Why is hemp rope generally preferred to all other kinds?

What is Manilla rope? and what used for?

For what would you use hide rope?

How is it made?

Is cotton rope used in the Navy when hemp can be procured? Why not?

Why is it used in the Merchant Service and for shore purposes?

Hawser-laid rope is almost always made right-handed, either of three strands or four: sometimes it is, however, made left-handed for certain purposes, and is said to be more pliable; can you say why?

What is the length of a coil of rope?

Answer—Hawser-laid, 113 fathoms; Cable-laid 101 fathoms.

What is Oakum, and what used for?

What kind of rope are cables and hawsers?

Why is a *heart* put in shroud-laid rope?

Why is three-stranded rope proportionably stronger than

four-stranded? and either hawser laid or shroud-laid proportionately stronger than cable-laid rope?

Where is hemp grown? and which is considered the best?

What books would you consult in order to find out the strength and weight of rope?

What is the advantage of using a Spanish fox?

When or where are the following hitches, knots and bends used?—viz:

Two half-hitches; timber hitch; rolling hitch; clove hitch; black-wall hitch; marline hitch; marlingspike hitch; square knot; bowline; running bowline; bowline on the bight; Matthew Walker; spritsail sheet; shroud knot; French shroud knot; diamond knot; double diamond knot; stopper knot; rolling bend; fisherman's bend; studding sail bend; carrick bend, and sheet bend?

How are hawsers bent, and why?

Suppose in bending two hawsers you have no seizings?

How would you bend a hawser to the ring of an anchor?

How bend a sheet cable? (Hemp.)

When is a clinch used?

What is a Nipper, and its use?

When use a Cat's paw?

What is a Turk's head used for?

What is the use of a grommet? a selvage strap? a warped strap? a pudding on a mast, yard, or anchor ring?

Why are the rings of anchors not puddened now-a-days?

What is the object of pointing and grafting ropes? hitching over ring bolts, and whipping the ends of ropes?

What is a flat-seizing used for? a round seizing? a throat seizing?

When is a short splice used, and when a long splice?

What is the comparative strength of splices?

Answer—About one-eighth.

Why is a rope wormed, parcelled and served?

When is a strand put in a rope?

When or where is a rose-lashing used?

What is sennit used for?

What is a sword mat used for?

When are cringles worked in ropes?

What is a buoy and its use?

What is "bleeding" a buoy?

When is a sheepshank used?

What is woolding?

What is a fighting stopper?

Answer—A fighting stopper is used in action in case of a stay or shroud being stranded or shot away. There are two kinds in general use: the first consists simply of a piece of 3 or 4 inch rope, about three feet long, with a stopper-knot at each end, and laniards spliced around the rope next the knots. It is used in case of a stay or shroud being stranded.

The other is made as follows—Two pieces of rope, the required length, are middled; dead eyes seized in the bights, and the tails coach-whipped. The laniard is rove and an eye spliced in each end as either end becomes the standing part, according to whichever happens to be put on uppermost. The rigging is brought to by taking a half-hitch with each tail opposite ways round the shroud, dogging the upper tails upwards and the lower ones downwards along the shroud, above and below the part that is stranded or shot away, and securing it with a nettle in each tail. The double block of a stout jigger is then hooked to a selvage strap round the shroud, above the stopper, and the single block to the eye in the laniard in the lower dead-eye. The eye in the other end bringing up against the dead-eye acts as a knot, and the shroud is then set up.

Stoppers are only put on the standing rigging.

What is a girtline or gantline?

Answer—A rope rove through a single block, either at the sheer-head or mast-head. Gantlines are of different sized ropes. In heavy work, such as sending up trussletrees or tops, 3 or 3½ inch rope is required.

How is the size of a dead-eye, a rope, a chain, a spar and a block, expressed?

Answer—The size of spars, dead-eyes and chain, is expressed by their diameters; of rope by its circumference, and of blocks by their length.

How are ropes intended for tacks and sheets made?

Answer—They taper towards the end for a reason that is evident. The only objection to this way of making them is that they cannot be shifted "end for end."

Is there any other kind of rope besides that already mentioned?

Answer—Yes. Wire rope—and frequently used in the Merchant Service, but objectionable in a man-of-war on account of the effect of shot.

Round-linked chain is also a good deal used, especially for topsail sheets.

Are blocks strapped always with double straps for strength?

Answer—No—they are frequently double-strapped to give the proper lead to the sheave; example; leading-blocks at fife-rails, &c.

How do you turn in a dead-eye?

Answer—The thing to be considered in turning in a dead-eye, is simply to keep the *lay of the rope in*—therefore, make a turn with the shroud with the lay, tar the score of the dead-eye, and place it in the turn with its upper hole next the cross; pass spun-yarn seizings through the lower holes around the shroud, to keep the dead-eye in place. Then with a bolt through the upper hole rig a Spanish windlass, break the end in, and pass a throat-seizing. Put a small jigger on the end and standing part of the shroud, and pull the end taut up along it; pass then the quarter and end seizings.

The ends, which to preserve them from the wet, are always taken inside, are capped.

With shroud-laid rope, how will the ends lie?

Answer—Forward on the starboard and aft on the port side. This rule is not, however, always observed by riggers.

How is the laniard rove, and what is its size?

Answer—The knot on the standing part comes on the inside of the upper dead-eye, under the *end part* of the shroud. It is rove from in out, through the first hole in the upper dead-eye; from out in, through the corresponding hole in the lower dead-eye, and so on alternately; and is secured round the upper dead-eye with a cow-hitch and the end stopped down the other parts.

Laniards are half the size of the shrouds.

Why should the knot come under the end part of the shroud?

Answer—Because the strain in setting up coming more immediately on the *running part* of the laniard, the dead-eye and seizings would otherwise be apt to slew. After heavy weather at sea we frequently find the seizings require squaring for a similar reason.

Which is the strongest way of turning in a dead-eye?

ANSWER—With the end up. The method of *cutter-stay fashion* was never much used in the U. S. Navy, though approved of in other services.

How are the lower dead-eyes placed and secured?

ANSWER—The lower dead-eyes, placed on the edge of the chains, are iron strapped, and the straps connected with the chain plates.

In what other way is lower rigging set up?

ANSWER—By means of *screws;* in which case the shroud is turned in round a thimble in the upper part of the screw-plate. The rigging is set up by simply shipping a leaver and *screwing up.* Large ships now have their lower stays and shrouds set up in this way, and it is probable that the old plan will go entirely out of use.

This fitment interferes less with the training of the spar-deck guns than dead-eyes; but would occasion more damage if struck by shot.

What is the distinction between running and standing rigging?

What is a boarding-netting, and how is it made?

What is splinter netting, and how is it made?

Sketch a "fighting stopper."

Show by a sketch how the lower rigging is set up, either with dead-eyes or screws.

Show by a sketch how the lower dead-eyes are placed and secured.

CHAPTER II.

BLOCKS AND TACKLES.

Blocks are variously shaped, according to their use and situation in the ship. A block consists of a *shell, sheave* and *pin;* and from the number of these sheaves it takes its name, viz: a block with one sheave is called *single;* with two, double, &c; and with four, *four-fold.*

The shell of a block is made of ash or elm, and has one or two scores cut at each end, according as it is to be strapped. In the centre of the sheave is a hole for the pin. The shell is hollow, and in the inside is placed a wheel, called a sheave —made of lignum vitæ, brass, or iron.

In the centre of the sheave is also a hole for the pin on which it turns. This is strengthened by letting in a piece of brass, called a *bush.* Round the circumference of the sheave is a groove for the rope.

The sheave is placed in the shell, and the pin is put through both shell and sheave. Blocks are strapped with rope or iron.

A single block has one sheave; *a double block,* two; *a treble block,* three, &c.

The size of a block is denoted by the length of the shell, and the quality by the degree of flatness or thickness, number of sheaves, scores for strapping, and nature of strapping —for instance: a brace block is (say) 20-inch, single, thin, and double scored. A tye-block is single, thick, and iron-bound.

A shoulder block has a shoulder or projection at the lower end, to prevent the rope reeving through it from jambing. Used for topsail sheets, lower lifts, &c.

A fiddle block is made like two single blocks, one above the other; the upper block larger than the lower. Used for yard tackles, burtons, &c.

A shoe block is also made like two single blocks, but the

sheaves lie at right angles to each other. Used for main buntlines, &c.

A snatch block is a single block, iron bound, with a swivel hook; an iron clasp is fitted on the iron strap with a hinge to go over the *snatch* which is left in the side of the shell above the sheave. Used for "snatching" the bights of leading-ropes and falls.

A viol block is a large snatch block; used for "snatching" the bights of large ropes or hawsers.

A sister block has two sheaves, one above the other. A score is cut between the blocks, and one at each end, for seizings. The shell is hollowed out on each side for a shroud to lie in. Used for topsail-lift and reef-tackle blocks; seized in between the two forward shrouds of the topmast rigging.

A secret block has a shoulder on each side of the cheek next the end where the strap passes, and the shell nearly covers the sheave hole. Used for clew-garnet blocks, &c.

A monkey block is a single block on a saddle; to nail upon yards, &c.

A tail block is a single block strapped with one or two tails.

A top block is a large single block, iron bound, with a swivel hook. Used for reeving the top pendants.

A nine-pin block is shaped like a nine-pin, and is placed in the fife-rails for reeving running-gear.

A cat block is three-fold, iron bound, with a large hook attached to it for the purpose of hooking to the ring of the anchor when catting.

A purchase block is a large three or four-fold block; it has two scores in the shell, and is double strapped. The strap is wormed, parcelled and served and spliced together; then, being doubled, the splice and the other bight are put over the block. The seizing is clapped on both parts, and is crossed both ways through the double parts of the strap. The largest four-fold block generally put on board a large ship is a 30-inch; weight about 540 lbs.

A dead eye is a large circular piece of wood, having a groove in its circumference for a shroud to lie in. Three holes are bored in it for a laniard. Used for setting up lower rigging.

A heart is a block of wood, of lignam vitæ, with a large

hole in the centre; at the bottom are four or five scores—round the outside a groove is cut to admit the stay.

A bull's-eye is a kind of wooden thimble with a groove in the circumference. Used for setting up top-gallant rigging; fair-leaders, &c.

A rack is a piece of wood, through the holes of which belaying-pins are stuck.

An euphroe is a long piece of wood having a number of holes, through which the crow-foot for the awning, &c., is rove.

Cleats are pieces of wood for various purposes. There are *sling cleats:* used on the slings of the yards; *stop cleats:* used on bowsprit for collars, &c.; *belaying* and *mast cleats:* used for belaying rigging; *horn cleats:* used for the same purpose; and *comb or B-cleats:* used for leading a rope through so as to keep it in place.

Shroud cleats are belaying cleats lashed on a shroud.

Large cleats are called *keoils.*

A Jacob's ladder is a rope ladder with wooden rounds. Used for stern ladders, fighting ladders, rigging ladders, &c.

A horse block is a platform used in flush-decked vessels, for the officer of the deck to stand upon in working ship. It is raised about four feet from the deck.

Can hooks are broad, flat iron hooks, in the eyes of which thimbles are inserted. Used for lifting casks, &c.

Slings are long straps used for slinging barrels, &c., preparatory to hoisting them on board.

Questions—What is a *patent block?*

Answer—A patent block is one in which the sheave-hole has a set of composition rollers to relieve the friction on the pin. They have never been much used in the Navy, though generally adopted in the Merchant Marine.

What is meant by blocks being equally large in the *swallow?*

Answer—That they will receive the same size rope.

What are the *cheeks* of a block?

What is the proportion for the size of straps?

Answer—Between ¼ and ⅓ the size of the block; a 5-inch block has a 1-inch strap; a 6-inch block a 1½-inch strap; a 7-inch block a 2-inch strap; a 9-inch block a 2½ inch strap;

a 11 inch block a 3½-inch strap; a 13-inch block a 4½-inch strap; a 16-inch block a 5-inch strap; a 19-inch block a 7-inch strap; and a 21-inch block an 8-inch strap.

What is the proportion of blocks to the ropes to be rove through them?

Answer—The block should be three times the size of the rope.

Why are fiddle blocks used for burtons, yard tackles, &c.?

Why have some blocks swivel-hooks?

How would you hook a top-block?

What are *lock-thimbles*, and for what used?

Are the shells of blocks *always* made of wood?

Answer—No—sometimes of metal; and when preserved from rust, they present much less friction than wooden ones. They are usually denominated by their lifting strength. For example: to lift 5 tons requires a 10-inch block; 4⅝ inch in diameter sheave, 1⅛-inch thickness of sheave; 3-inch rope, or 5 16-inch chain, and the weight, if double, would be 29 lbs.

In what does the inspection of blocks consist?

Answer—Blocks should be frequently examined, not only as to strapping, but also by knocking the pin out and inspecting the bouching (or bushing). The loss of power and strain on rope occasioned by a worn bouche is considerable. The working blocks of tackles, (the fly-block of topsail halliards, for instance,) are always more worn than the lower ones, and the sheaves should be renewed, if necessary. That sheave on which the hauling part of the fall comes does most duty; for although it is assumed in mechanics that strain is equally borne by all parts of a rope in a tackle, practice shows that the hauling part is most worn and strained. All blocks which stand horizontally, as lower brace blocks, must be placed with the head of the pin upwards, as otherwise it is liable to fall out when the shell shrinks.

All blocks in large purchases are liable to split if hove suddenly "two blocks." Creaking blocks are never allowed in a Man-of-War.

What is the proportion for hooks?

Answer—There is no proportion for hooks, and accidents frequently happen by their straitening. It is customary to use a shackle, lashing, or toggle, for heavy weights. A hook is strengthened by slipping a link over the point.

Where do you use hearts instead of dead-eyes, and why?
What is the use of an euphroe?
What is a fighting ladder?
What is the "bill" of a hook?
Sketch the various blocks described.

TACKLES.

Tackles are named according to the number of blocks employed, and the arrangement and size of gear. The rope rove is the *pall;* the part made fast, the *standing part;* and the part hauled on, the *running part*, or *end*, or frequently also the *fall.*

A jigger is a small tackle.

A burton is a rope rove through a single block and a fiddle block; the standing part made fast to the single block.

A whip is a rope rove through a single fixed block.

A double whip is a rope rove through a single moveable block.

A gun-tackle purchase is a rope rove alternately through two single blocks; the standing part made fast to the moveable block.

A luff-tackle purchase is a rope rove through a single and a double block; the standing part made fast to the single block.

A two-fold purchase is a rope rove through two double blocks; the standing part made fast to one of them.

A *three-fold purchase* is a rope rove through two treble blocks; the standing part made fast to one of them.

A *four-fold purchase* is a rope rove through two four-fold blocks; the standing part made fast to one of them.

Large tackles are called, in general, *purchases;* smaller ones, *luffs* Combinations of tackles may be variously made; thus we have: *a whip and runner; a whip upon whip; Spanish burtons* (of various kinds); *a runner and tackle,* &c.

The general rule for ascertaining the power necessary to raise a weight with a tackle is to divide the weight by twice the number of sheaves in the lower or *moveable* block; the quotient being the answer. Thus a *single whip* gives no in-

crease of power, but is used to give a more convenient *lead*; *a double whip* doubles the power; *a gun-tackle purchase* trebles it, (provided the standing part is at the moveable block); *a luff tackle* increases it four-fold, (provided the double block is the moveable one); *a three-fold purchase* increases it six-fold; *a four-fold purchase* quadruples it, &c.

A whip and runner quadruples the power; a runner and tackle increases it eight times; a luff upon luff, sixteen times, &c.

Another way to arrive at the power gained by a tackle, is to state it thus: "The power gained by a tackle is as the space travelled over to raise the weight to the space travelled by the weight at the same time;" but perhaps the theory of tackles will be best understood thus: in a double whip the strain is equally distributed between each part of the rope; and there being two parts employed in sustaining the weight, it is balanced by an exertion of power equal to one-half its weight; and the same principle applies to tackles of all kinds.

It must be observed that *fixed* blocks give no gain—a maxim which should always be borne in mind when using tackles; for example: in using the train tackle (a luff), to run in a gun; if the double block is hooked to the gun, the power is increased four-fold; but if the single block is hooked to the gun, the power is only trebled.

Old seamen and others accustomed to the use of ropes know *by experience* the power of tackles, kind required, &c., without being able to explain *why;* the young officer, by studying the *principle*, enjoys the advantage of entering upon the subject *knowingly* from the beginning. In tackles, as in other machines, whatever is gained in force is lost in time, and whatever is gained in time is lost in force. The convenience of a machine consists in enabling a small force, working by a succession of efforts through a great space, to raise a great weight, or to overcome a great resistance through a small space. If one man can do a piece of work in 10 days, ten men can do it in 1 day; there is, therefore, no saving of labor from using tackles, but *a loss* because of friction; but the advantage of using them is that a small force can produce a great effect by allowing more time. When machinery *can* be dispensed with, *direct handling* is the quickest of all modes for moving weights.

In what has been said concerning tackles, no account has been taken of *friction*.

When a weight hangs by a tackle at rest, all the parts of the fall bear an equal strain, and the weight will be balanced by one at the end of the fall as many times less as there are parts of the rope at the block to which the larger weight is suspended. But directly the fall is hauled upon, this ceases to be the case. In consequence of *friction*, there will not be an equal strain on all parts of the rope, and it becomes necessary, in calculating the practical power of the tackle, not (as before,) to multiply the force by the number of parts of rope at the moving block, but to find the strain, or tension, on each part, and add all together.

To do this exactly is difficult, if not impossible, as the different tensions of the parts depend upon so many varying circumstances—such, for instance, as the flexibility of the rope, which differs according to its size, newness, dryness, and material; the relation of the diameter of the sheaves to that of the pin; the material of these, and their condition; upon all which the amount of resistance caused by friction depends. All we can do is to give some rough rule, which may be to some extent practically useful.

Of two sheaves, the pins being the same, the greater will work the easier. The smaller, and consequently more flexible, the rope, the less the friction. It will not be far wrong, in ordinary cases, if it is assumed that one-sixth of the original force is consumed by friction each time that the rope passes round a sheave. Thus: supposing the tension or strain on the hauling part to be 6, that on the next will be 5, the next 4, the next 3, and so on. So that if the strain on the fall of a two-fold purchase be 6, the tensions on the parts of the rope will be represented by the figures 6, 5, 4, 3, and their sum 18 will nearly represent the power of the tackle, instead of 24, which it would have been had there been no friction; or about *one-fourth* of the force would have been consumed by it.

Suppose a weight of 24 to be suspended by the above tackle. If the fall would just bear a weight of 6, the four parts would be sufficient to suspend the weight; but if it were required to raise it, we must have a rope at least one-third stronger, or equal to sustain a weight of 8. The tensions

would be, according to the above rule, 8, $6\frac{2}{3}$, $5\frac{1}{4}$, and 4, and their sum will be 24, which is what we require to lift.

From these considerations, we gather: that work is lightened by using large blocks and small ropes; that the hauling part of the fall bears about double the strain of the standing part; that as the pin of a block is more worn on one of its sides, it should be frequently turned; and that as sheaves nearest the standing part do least duty, they should be shifted occasionally with the others.

QUESTIONS—How is the standing part of a gun-tackle purchase secured? A yard-tackle? A three-fold purchase?

Why is the *becket* to which the standing part of a tackle is secured often much smaller than the fall, and still considered strong enough?

Sketch on the black-board a jigger, single and double whip, gun-tackle purchase, and others mentioned in the text.

Show also how the power gained by each is calculated.

Give an example of the use of a single whip, whip and runner, luff-tackle, and others.

Reeve the several Spanish burtons in use, and show how the power gained by each is calculated—illustrating by a diagram on the board.

Raising a barrel weighing 200 lbs. with a single whip on the main yard, what power must be put on the fall, and what is the strain on the yard?

Raising it with a double whip, what power must be applied, and what will be the strain on the yard?

Raising a weight of 4 tons with a two-fold purchase, what power must be applied? and what will be the strain on the yard?

As the main brace is usually rove, suppose the strain on the yard to be represented by 2, the strain on the fall by 1, what number will represent the strain on the bumpkin?

What is the usual deduction for *friction?*

ANSWER—One-fourth for ordinary tackles, and one-third for a three-fold purchase.

Wishing to apply a luff-tackle, which block would you make the moveable one, and why?

Wishing to raise a weight of 40 tons, what sized rope would you reeve as a three-fold purchase?

ANSWER—Divide the weight to be raised by the number of parts at the moveable block to obtain the strain on a single part; add one-third of this for the increased strain brought by friction, and reeve the rope of corresponding strength (as per table). One-sixth of 40 tons is $6\frac{2}{3}$ tons, which, with one-third added, is 9 tons nearly; for which the table gives us a 6 or $6\frac{1}{2}$ inch rope.

What is the proportionate strength of rope of different sizes?

ANSWER—The strength of ropes varies with their areas; and as the areas of circles are proportioned to the squares of their circumferences, we have $\frac{S}{s} = \frac{C^2}{c^2}$; S and s representing the strength.

Is two parts of a 4-inch rope equal to one part of an 8-inch?

ANSWER—By the formula we have 64-16=4; hence it will take four parts of a 4-inch to equal one part of an 8-inch. Consulting a table, we find that an 8-inch rope will bear a strain of 20.4 tons, while a 4-inch rope will bear but 4 tons. The rule, as given, takes no account, however, of the angle of twist which affects the strength of the rope.

What practical rule is there for ascertaining the strength of a rope?

ANSWER—The square of half the circumference gives the breaking strain of the weakest hawser-laid rope expressed in tons, and is therefore a safe rule.

What is a practical rule for calculating the weight of tarred rope?

ANSWER—The square of the circumference divided by 4 equals the weight of a fathom in pounds; or multiply the square of the circumference by the length in fathoms, and divide by 4.24 for the weight in pounds of the whole.

What is the practical rule for determining the relative strength of chain and rope.

ANSWER—Consider the proportionate strength of chain and rope to be ten to one, using the diameter of the chain and the circumference of the rope. Half-inch chain may, therefore, replace 5 inch rope.

How is the strength of chains determined by rule?

ANSWER—Divide the square of the diameter in eighths by 2.4 for round-linked crane chain; and by 2.7 for chain cable.

Example: 1½-inch round-linked chain: By calculation, 144-2.4=60 tons.

The above rules are approximate. Most works on Seamanship contain tables containing the exact weights, strength, &c., of ropes and chains.

Wire rope is rather more than twice as strong as hempen.

A 3-inch hemp =5-16 chain=1½ wire.
A 5-inch " =½ " =2 "
A 7-inch " =¾ " =3 "
A 9-inch " =1 " =4 "
A 11-inch " =1¼ " =5 "

What is the strongest description of rope?

ANSWER—Untarred, white, three-stranded rope; and the next in the scale of strength is the common three-strand hawser-laid rope, tarred.

Hawser-laid rope is stronger than cable-laid in the proportion of 8.7 to 6.

Define the expressions, *Sway; sway aloft; heave; heave round; hoist; hoist away; man; clap on; heave up; two blocks; fleet the purchase; avast; belay; take a turn; ease away; lower; lower away; veer; surge; stand by; roundly; handsomely; by the run; parted; carried away; haul taut; walk away; send a hand; haul down; trice up.* Give examples in which each of these expressions is used.

Show on the black-board how the fall of a three-fold purchase is rove.

[The instructor will sketch on the board various purchases—such as: the topsail halliards, the main tack, clewlines, jib halliards, &c., and require the student to name the power gained by each.]

Experiments by Captain Cosk—French Navy.

"In a tackle of 9 sheaves, 5 upper and 4 lower, the ratio of the *power* to the *weight* in hoisting is as 1:4; but only as 1:12 in sustaining it in equilibrium. The standing part in hoisting experiences the strain of only 1-40th the weight;

but in lowering it is equal to that which the hauling part experiences in hoisting. The strap of the upper block ought to be four times as strong as the fall; or twice its size.

In a tackle of 6 sheaves the fall experiences an effort equal to $\frac{1}{5}$ the weight when hoisting, and only 1-10 in a state of equilibrium. The upper strap should be able to sustain an effort once and a third of the weight lifted; or to have four times as much strength as the fall.

A tackle of 4 sheaves requires an effort of $\frac{2}{3}$ the weight on the fall in hoisting, and only $\frac{1}{4}$ to keep it in suspension. The strap should be three and a half times the strength of the fall."

CHAPTER III.

DOCKS.

Docks are of three kinds: *Wet*, *Dry*, and *Floating*.

Where there is a regular and considerable rise and fall of tide, excavations are made in the land near the water, faced with solid masonry, and mostly having entrances fitted with gates or *caissons*, which serve either to retain or exclude the tidal waters as desirable. Those on a larger scale, and which are always kept full of water, are called "wet docks," or basins. These are in fact artificial harbors, in which vessels are always kept afloat whilst undergoing internal repairs, loading, or unloading, fitting for, or being kept ready for going to sea. Commercial wet docks usually have "locks" (as in a canal) attached to them, so as to admit of the entrance and egress of vessels at any time of tide, without losing more water than necessary. In naval wet docks, the ships generally requiring as much water outside as in, one barrier, in the form of a caisson is used, and which is seldom worked except at high water.

The *Dry Dock* is both deeper and narrower. It is deeper because it is necessary to have more water in the dock at the time of docking a ship than at its entrance. This is for the purpose of gaining depth enough for the *Angle Blocks*, on which the keel of the ship is to rest, and is effected by having the floor of the dock somewhat below the low-water mark. Then after closing the entrance, the dock is drained by pumping and letting the water run off with the falling tide through channels, called *Culverts*. It is narrower, because when not water-borne the ship requires to be supported by *Shores*, which abutting on the sides of the dock bear against those of the ship on being set taut by wedging.

Formerly the ship, when in dock, rested on a row of square blocks of wood, which were kept in their place with ballast. In order to get at her keel for repairing, or coppering, &c., it was necessary to lift her bodily off the blocks by numerous shores, simultaneously driven up with wedges. This opera-

tion not only involved the services of hundreds of mechanics, but the ship became strained at every fastening in consequence of being thus borne in the air. The *Angle Blocks*, which were introduced by Seppings, admit of removal and replacement in succession at such places as require repair; not only with a very few hands, but without the least concussion to the ship.

The *Caisson*, or *Floating Dam*, is a vessel whose length is equal to the breadth of the dock entrance. Both its ends are formed like the bow of a ship, and the keel is continued up each stem. It is ballasted and fitted with valves or penstocks, and so formed that when full of water and in its place across the entrance, the stem and keel fit accurately into a groove cut in the masonry on the sides and across the bottom of the entrance, the passage of water being thus prevented. When it is necessary to remove the caisson, the water is either run off at low water or pumped out; and as the entrance is widest at the top, the caisson, on being floated up on the rising water, becomes cleared of the grooves, and is withdrawn.

The *Graving Dock*, according to naval distinctions, is open. In it vessels are grounded at high water, for the purpose of receiving trifling repairs on the fall of the tide. Before the introduction of copper sheathing, they were used for the purpose of *breaming* or cleaning the bottom by fires. In the construction of these docks, serious difficulties and great expenses are incurred. The soil may be so porous that the excavations may be swamped at every high tide; so rocky as to require the severest labor, or so soft that artificial foundations for the masonry have to be formed. They are also subject to the inconvenience of being dependent on tidal action and sufficient depth of water.

The margins of rivers or harbours do not always afford facilities for the construction of ships or docks just in those places where it is desirable to build or repair ships. The ground may be already occupied, the banks may be shallow and marshy; or there may not be a sufficiency of tide. Recourse is then had to a *Floating Dock*, which is a wooden, water-tight, flat-bottomed, box-shaped vessel, of sufficient capacity to bear, when afloat, the weight of the vessel, workmen, and materials employed on her. In some cases this

float works in an enclosure of masonry, at the bottom of which, when full of water, the float lies.

When the vessel is brought over it, the valves are closed, the water is pumped out, and the vessel is carried up on this great stage to a dry level. When the repairs are completed, the valves are opened, the stage sinks, and the vessel floats out.

But in general, the float is open at the top, and one end is fitted so as to remove or turn down when requisite. Not being connected with any other structure, it may be moved, whether laden or unladen, to any part of the harbour. On turning the end down, or removing it, the float sinks sufficiently to admit the vessel. On replacing it and pumping the water out, the vessel remains dry. Where there is "rise and fall," the float is beached at high tide; the water runs off on the ebb; the end is caulked in; and on the next flood, the float being flat-bottomed, is hauled still further up.

Moreover, however valuable for hauling up vessels slips may be, there is always difficulty and strain with large ships. In America, vessels are brought over a sunken, hollow raft; on the exhaustion of the water from which, the ship is borne to the surface, and lies on a cradle high and dry, with a surrounding platform for the shipwrights to work on. Thus the ship is kept in a horizontal position, without risk of strain and is always floatable.

A very complete substitute of this kind, for the regular dock, is Taylor's. It is made of iron, with double sides in compartments. Its entrance is closed by a caisson, and the pumps are worked by a steam engine. When the ship is received, and the gate closed, the water is immediately run off to an equal level into the empty compartments, and the remainder pumped out.

A *Coffer Dam* is an enclosure outside a work formed by a double row of iron-shod piles, driven into the bottom so close together as to be nearly water-tight. Clay is rammed in between them and the water inside pumped out.

The principle of the Coffer Dam has sometimes been applied to working on the bottoms of ships—such as putting on a sheet of copper, or stopping a leak—with success.

The *Slip* is an inclined plane formed of solid masonry on the banks of a harbor or river, and carried out some distance

beyond the low-water mark. In building, the ship's keel is laid on this on blocks, inclining to the horizon at an inclination of § of an inch to a foot in her length. As the fabric rises it is supported by shores; and when the ship is completed the *Cradle* is placed underneath, and her weight, by a process of wedging, transferred to it. When set close up in its place, this cradle fits like an outside framing of bottom timbers. It is supported by "stopping-pieces," and shores called "poppets," resting upon sliding "*ways*," which extend along the slip in lines parallel to the keel. These *ways* are well soaped; and other supports and fastenings are knocked away and the ship glides into the water, or is "launched." The cradle then disengages itself, and the ship is carried into dry dock for the purpose of having such fastenings as were temporarily cleated on the bottom, for the top of the cradle to bear against, removed, and the process of coppering effected.

The *Patent Slip* is an adaptation of the common slip to the purpose of repairing vessels. Carriages, in number according to the length of the vessel, fitted with cog-wheels and working on corresponding racks are run out under the bows of the vessel. When secured upon these, she is hauled up either by capstans or steam machinery.

MODES OF WORKING SEVERAL GOVERNMENT DOCKS.

STONE DRY DOCKS.

1st. Ascertain as nearly as possible the line of the ship's keel, then arrange the blocks in the Docks to conform as near as may be to the line of the keel, always allowing the ship to settle in the centre a little. Let the ship be upright, without heeling to either side; have the shores arranged on each side of the dock ready for use. Open the filling *Culvert* gates, and when the Dock is full, open the *turning gates;* haul the ship into Dock and shut the gates. Place the ship in the centre of the dock, start the pumps, and as soon as the keel touches the blocks, set up the horizontal shores, by screws or wedges. As the water recedes from the Dock, leaving the lower *altars*, other lines and shores must be placed and set up with wedges. As the water is pumped out the

altars should be washed off, that the workmen may have a clean dock for their operations. When all the shores are in place, and the ship properly secured, go to work. In docking large ships, such as heavy frigates and line-of-battle ships, it sometimes becomes necessary to stop the pumps for a few moments, occasionally, in order to give the workmen time to get up a sufficient number of shores to secure the ship's safety; which could not always be done with an ordinary crew of workmen, if the pumps were kept at full speed.

SECTIONAL FLOATING DOCK.

In the *Sectional Floating Dock*, the stability of the structure is secured by end floats, which glide up and down in frame work provided for that purpose; they also serve the purpose of ballast, for sinking the dock to receive a vessel. When a ship is to be raised upon this dock, the water is let into the tanks, and the machinery put in motion, to raise the end floats, by which means the tanks are forced down to the proper depth to receive the vessel. The ship is then hauled in between uprights, placed in the centre, and the end floats are let down, so that the tanks rise gently until the keel touches the blocks; the side horizontal shores are then placed to keep the ship upright, and the pumps are put in motion. When the tanks begin to press firmly against the keel, the bilge blocks are drawn under the ship, and the pumping proceeds until the ship is lifted out of the water; care being taken to work the pumps in the different sections in proportion to the displacement of the ship resting upon them.

If the vessel is to be taken on shore by means of the Basin and Railway, the next operation is, to bring the bottoms of the tanks in a plane, which is done by heavy bed-screws applied to any tank which may be higher than the others. These screws are set against the ship's bottom, and their effect, when turned, is to force the tanks down deeper into the water. When all the tanks are so arranged as to present an even surface to the floor of the *Basin*, the structure is hauled into the Basin, the valves in the tanks are opened, and sufficient water is admitted to sink the dock and firmly ground it on the floor. The *cradle* is then placed under the ship, the hauling apparatus applied, the engine put in operation,

and the ship hauled ashore upon the Railway. If necessary, the ship may then be shored as on a building *slip*, and the cradle can be removed so as to give the workmen free access to all parts of the keel and bottom.

BALANCE FLOATING DOCK.

The Balance Floating Dock is provided with side chambers, to answer the same purposes as the end floats in the sectional dock. In these chambers are compartments, into which water is raised for the purpose of sinking the Dock to receive a vessel. If a ship is to be raised and hauled on shore by means of the *Basin and Railway*, the cradle is first put in the dock, the dock is then sunk by opening the valves and by pumping water up into the upper side chambers; when sunk to a proper depth, the ship is hauled over the cradle and placed in the centre of the dock, the water is then let off from the upper chambers, which causes the dock to rise gently until the keel touches the blocks, when the horizontal shores are placed to keep the ship upright. The pumps are then put in operation, and as soon as the ship has a good bearing on the cradle, the bilge shores are drawn under her and all the water is pumped from the dock. The structure is then floated into the Basin, water is admitted into the Dock to sink it upon the floor; the hauling apparatus is now applied, the engine put in operation, and the vessel drawn on shore. As in the case of the Sectional Dock, if necessary, the vessel may be shored as on a building slip, and the cradle removed to give the workmen free access to the keel and bottom.

If the vessel is not to be drawn on shore by the Railway, the cradle is not used in the Dock for the purpose. The process of raising would be the same as in the other case.

CHAPTER IV.

CONSTRUCTION.

Vessels are built on *slips*. The timber chiefly used is oak, elm, fir, teak, larch, pine and mahogany. It is divided into three sorts, viz: *square*, which is the full size of the tree, having only its sides squared off; *thick stuff*, which is square timber cut into different thicknesses, from 4½ inches to 10, but the whole depth of the tree; and *plank*, which runs from 4 inches down to 1½; all under that size being called *board*.

Deals occur in length of 10, 12, and 14 feet, varying in thickness from 3 inches to ½ inch, and averages 9 inches in breadth. Those which are ½ inch thick are *flat deals;* 1¼ inch are *whole deals*.

Kyanising and *burnettising* are somewhat similar processes by which timber, canvass and cordage are so readily seasoned as to be preserved from the injurious effects of dry-rot, mildew, &c., and premature decay.

Formerly all curved timbers were selected from the natural growth; latterly timber-bending machines have been used to bend the timber into the desired form, at a great saving of labor and expense.

Timbers are joined together by *scarphing*, *morticing*, *halving*, *dovetailing*, &c., and when great strength is required it is usual to make use of *coakings*, *bolts*, and *iron bracings*.

Bolts occur in great variety; their sizes are denoted by their diameters, and their particular dimensions are determined by the tension to which they are meant to be exposed; generally speaking, that should not exceed one fifth of their tabulated strength. They are made of iron, copper, and a composition of copper and zinc. When bolts have to resist great strain in the direction of their length, their points are riveted, clenched, or fore-locked over a ring or washer.

The adhesive force of bolts or nails is greater when driven across the grain than with it.

In the MOULD LOFT are to be found the drawings of the vessel which the designer purposes to build. By these the form and dimensions of every particular piece of wood that is to enter into the structure are determined.

The principal one is the *Sheer Drawing.* It represents the vessel in her length, breadth and depth, and is composed of three plans, viz: the *sheer plan*, which is a vertical section passing through the vessel in its whole length, fore and aft, dividing it into two equal parts. On this plan are represented the length and depth of the keel, the rake and height of the stem and stern-posts, the position of the frames, water lines, decks, ports, masts, channels, rudder, screw-aperture, &c. The *half-breadth plan* contains the several half-breadths at every frame of timbers at the different heights of the water lines, main breadth, top sides, riband lines, &c. The *body plan* represents transverse or athwart-ship sections of the ship, perpendicular to the keel. The several breadths and particular form of every frame of timbers are described on this. In the body plan, the half-breadths of the fore-body are shown on the right, and those of the after-body on the left of the middle line.

The *principal dimensions* are marked on the plans—such as: length between perpendiculars, length of the keel for tonnage, extreme breadth, moulded breadth, breadth for tonnage, depth of hold, and burthen in tons.

From these drawings the form of the ship is "laid off" in full size on the floor of the mould-loft. Moulds of thin fir boardings are then framed, and by these the timbers are worked into shape.

The *keel* is made of elm in pieces, scarphed and coaked together.

The *stern* is connected with the fore end of the keel by a knee, and is strengthened on its after side by the *apron* and *stemson*.

The *knight heads* rise from the apron on each side of the stern.

The *stern-post* is connected with the after end of the keel by tenons and plates of metal; it is strengthened on its fore side by the *inner stern-post*, and its after side is fitted with braces for the rudder.

The *deadwood* are chocks of timber fastened along the

upper side of the keel, which form a seating for the *floor timbers*, and which are shaped into the form in the fore and after parts of the ship. In vessels intended for the screw an aperture is cut in the after part of the after deadwood, and an additional stern post, called the *body post*, introduced at the fore part of the cutting. Where the run is abrupt, the fore part of this aperture intrudes upon the body of the ship, and the flat surface is planked in athwart-ships.

The *keelson* lies fore and aft on top of the keel, deadwood, and floors, and being bolted through all, unites these timbers in one mass.

The *floors* are timbers extending on each side of the keel to about a quarter of the breadth of the ship.

A *frame of timbers* is composed of the floor timber, two or more *futtocks*, and a *top-timber* on each side; that which encloses the greatest space is called the *main frame*. The frames give the form to the vessel athwart-ships, are put together on the ground, their ends being connected by coaks, and then placed across the deadwood.

The *beams* serve to support the decks, as well as to connect and preserve the sides at their proper distance apart; their ends are secured above by the *water-ways*, beneath by the *shelf-piece*, and also by iron braces, or *knees*.

These are the principal timbers which compose the skeleton of the ship. The sides are connected with the stern and stern posts by iron fastenings called *breast-hooks* and *crutches;* and the whole fabric is further united by iron bands called *riders*, which run diagonally inside of the frame timbers. This additional strengthening is known as *trussing*, and acts against the inclination which the extremities have to droop or *hog*.

The *side keelsons* are short internal keels, which are laid about six feet on each side of the keelson. Their use is to divide with the floor timbers, the strain caused by the heel of the mainmast in its *step*.

In steamships there are no side keelsons, but similar *timber-sleepers* are placed in the same position, which, extending along the bottom the whole length of the engine-room, form a platform for the engine.

The *steps* for the fore and main masts are fastened across

the keelson; that of the mizen mast being usually fixed on the lower deck beams.

The *false keel* is an additional keel from 4 to 6 inches thick fastened on below the main keel.

The *gripe* is a projection at the fore lower part of the stern. Both these two last named pieces are meant to prevent leeway, and protect the adjoining timbers when the ship strikes the ground.

The *limbers* are spaces left vacant between the *limber-strakes* and the keelson, forming passages for water to the *pump-well*. These are covered by solid iron plates, which, resting on the edges of the keelson and limber strakes, exclude such matter as would be injurious to the pump valves. These plates, moreover, represent so much ballast.

The *planking* is the internal as well as the external *skin* of the ship. That which is outside is usually laid on in strakes placed "anchor-stock fashion," which is considered the strongest mode of arranging these layers. At that part near the water line, called the *bends*, they are of oak; and near the keel, called the *garboard strakes*, are of elm. This planking is fastened by *tree-nails* (pronounced *trunnels*), large wooden bolts, which, passing through and through, secure both these coverings of the inner planking; the principal are the *ceilings* in the hold; the *sperketing*, which run above the water-ways; the *clamps*, which run under the *shelf-pieces*; and the *limber strakes* which lie nearest the keelson.

The *channels* or *chains* are strong platforms on the sides abreast the masts, for the purpose of giving greater *spread* to the rigging. The bindings of the dead-eyes are let into the outer edges, and secured there by the *channel rail*, and an eye bolt is sometimes driven in on each side of the dead-eye for the laniards of the rigging.

The *bill boards* are iron-shod stools just before and abaft the fore channels on which the flushes of the anchors are stowed.

The *cat head* is a timber projecting on the top of the round of each bow by which the anchor is catted and stowed. It is supplied with sheaves, and fitted with eye-bolts, thumb-cleats and slip.

The *head-knees* project beyond the upper part of the stern,

supporting the *figure-head*, and are pierced inside with holes for the gammoning; and outside for the bobstays.

The *decks* are laid generally fore-and-aft; sometimes diagonally. The spaces left open for hatch and ladder ways are edged with timbers; those running fore-and-aft being called *coamings;* those athwart-ship, *head-ledges*; those which surround the masts and capstan holes being called *partners*. The decks are fastened by nails called *damps*, driven, as all iron nails in ship building are, with a twist of tarred oakum round the head. Wooden *plugs* are driven in over the heads of the bolts, for appearance sake—the bolts being driven in far enough to admit of it. The holes for the cables are strengthened by chocks, lined with iron, and are called the *trunks*.

The *riding-bitts* go through the decks, and are supported on their fore-side by knees, which are let down to the deck beams. When there is a cross-piece it is hooked on to the after side. All ships larger than small sloops-of-war have two pairs; those which have no cross-piece have moveable iron horns, called *battle-doors*, projecting from the outside, which serve to keep the cables up in ther place. The betts, as well as the *hawse-holes*, are shod with iron, and as this causes a severe *nip* to cables when riding out a gale, great care is taken to keep the cable shackles clear of both, as well as by veering a little occasionally (called "freshening the nip) to keep the chafe off any one particular part of the cable. Steamships have after bitts, for towing purposes, in addition.

The *ports sides* are formed by the timbers of the frame, and their upper and lower parts by timbers called *sills*. The *port lids* are made of fir, of two thicknesses, placed opposite ways. Each is pierced for a *scuttle*, which serves for ventilation, and also for the rammer staff, when the port is down. Port lids are secured by a wooden bar across the inside of the port. Through this two iron hooks project; these hook to ring-bolts in the lid, and are drawn in by iron wedges, and are "triced up" by a tackle and chainspan.

The *spindle of the capstan* passes through a metal-bushed hole in the partners, pivoting on a socket on the deck below; the upper part passes through the main piece, the *barrel*, on the sides of which are the *whelps;* these derive mutual support from chocks which are let in at top and bottom. The

top-piece, or *drum-head*, is strengthened by metal bands, and is pierced with holes for the *bars*, *pins*, and *drop-bolts*. The lower part of the whelps is enclosed by a metal band on which the *pawls* are bolted, and a corresponding circular plate, the *pawl-rim*, having cogs, is let into the partners, which, when the pawls are down in the proper direction, serve to secure the capstan from moving.

When ships have a double capstan, the point of the upper spindle is secured to a plate, which is received on another one on the head of the lower capstan. These plates have corresponding holes, and when it is desired to connect both capstans, the drop-bolts are entered.

Capstans fitted for chain-messengers are made with a *spracket wheel*, the teeth of which enter the *messenger* links.

In some cases the cable itself is taken partly round the capstan, the links either binding in corresponding indentations made on a metal casting, or else working on a sprocket-wheel; the cabb being carried to its own side round a friction roller.

When double capstans are supplied, the lower only is made to receive the chain messenger, or cable. They are usually worked in connection, and both capstans manned.

The *compressors* are arrangements for controlling the cables; those mostly used are iron levers placed under the beams over the cable lockers, and worked by tackles.

Mix-stoppers are also used to control the cables. They consist of a screw and lever and a *tongue*, working through a stout upright timber—one on each side.

Scuppers are usually placed up and down; but when given a little rake aft, they discharge equally well, and do not admit water so easily when the ship is rolling. The lee side of a lower deck may be kept dry by boring the *scupper-plugs* out and fitting a leather valve at the small end. The bow-scuppers will always be out of repair, and admit water, unless let well into the wood and made to stand upright.

The *hawse-bucklers* are wooden blocks, which, after the plugs are driven in, close up the hawse-holes inside. Those in one piece are called *blind* bucklers. They are secured by iron bars.

The *hold* is divided into the different compartments by strong oak *bulk-headings* or partitions, the planks of which

are tongued at the joinings of the edges with strips of iron. Those of the magazine are treble, and formed diagonally, each layer running in opposite directions—having felt and mortar between them. The top or crown is covered with thick planking, and also protected with mortar.

The *magazines* are entered through passages, the doors of which are perforated with scuttles sufficiently large for the passage of a cartridge-box, and is lighted by a lamp placed in the *light-room*.

[The Ordnance Manual contains all the information desired upon this subject.]

The *engine-room* partitions are of iron. A bulk-head of that metal running fore-and-aft on each side, leaving a space between itself and the ship's side, forms the *coal-bunkers*. By this arrangement the machinery is protected from injuries from a horizontal fire from an enemy. The bunkers are filled from the deck overhead, and are discharged through opening into the *stake-hole*. As one or other of these apertures is always open, no danger can arise from such explosions as occur when coal has been so closed in as to confine the hydrogen gas, which invariably generates, and which ignites upon the approach of flame. In the stowage of coals, its chemical properties must be considered, or else they will force themselves on our notice.

In *caulking*, the seams are driven open, (or *horsed*,) *reamed*, and *oakum* in proportion to the thickness of the planking driven in. They are then covered or *payed* with pitch or marine glue. The planking in the holds, called the *lining*, is only *chintzed*—that is, the oakum is neither hardened in nor payed.

Coppering is done to preserve the ship's bottom from the ravages of worms, &c. Lead and wooden *sheathing* was used until the introduction of copper in 1761 in the British Navy. In *sheathing*, the wood was closely studded with nails, and then overlaid with pitch: a process which was called *graving*. In *coppering*, the sheets are fastened on with composition nails; the sheets being 4 feet long and 14 inches wide, are placed lengthways with the sheer of the ship. Their lower edges overlay the upper ones of those below, and their after ones the foremost of those abaft them. This metallic skin fits so accurately as to wrinkle or become rent when the ship

has been strained, and thus denotes injury done to the fabric.

Copper sheets are described as 32 ounces, 28 ounces, 18 ounces, 16 ounces the superficial foot. The thickest are used near the bows and water line.

The *figures* on the side of the stern and rudder mark the ship's draft of water. They are each six inches long; the lower part shows the feet, and the upper the inches.

The main piece of the *rudder* is of oak, with an elm edging on the fore part; the after parts fir. Its head is circular and iron hooped, and the holes (*mortice*) for the *tiller* and for the key for the spare tiller are iron plated; the heel is covered by a *sole-piece*. The fore side of the rudder and after side of the stern-post are cut away (*bearded*) sufficiently to permit the rudder being moved to an angle of 42° from a fore-and-aft line, which, in steering, is considered the extreme point of efficiency. There is a strong metal strap on the after part, near the water line, to which the *rudder chains* are fastened. As it is with tackles from the quarters to these chains that the ship is steered when the *rudder head* is carried away, this strap should be well bolted through.

In steamships, where the position of the screw aperture interferes with the use of the usual tiller, a *yoke* is frequently used, and the rudder-head fitted accordingly.

The head is hoisted up through the "helm port;" the *pintles* enter the *gudgeons*, and the rudder is thus "hung."

The *rudder-chocks* are blocks of wood which are forced in alongside the head, to keep it steady, when desirable, as well as to prevent the rudder from being easily unshipped when touching the ground; a piece of wood called the *woodlock* is nailed on the foreside between the upper pintles.

Rudders are usually one twenty-eighth part the length of the ship

The *figure head* is part of a vessel rather decorative than useful, except as serving to denote the ship. The varieties are the *Figure Head* (proper), the *Fiddle Head* and the *Billet Head*.

Various kinds of pumps are used, such as the *wash-deck pumps, chain pumps, Massie's pump, Bilge pump*, &c.

In steam propellers the *body post* and *after deadwood* are bored through in a fore-and-aft line, and the passage thus formed is bushed with two metal pipes, through the inner-

most of which the screw shaft projects. The fore part of this pipe is made water-tight round the shaft by a collar and packing called the *gland box*, which is put on inside the ship; the after end is lined with strips of lignum vitæ. The projecting end of the shaft is fitted on its appearance outside with a metal head-piece into the mortice or "slot," of which the foremost end of the *boss* of the screw drops; and this connection is made permanent by the downward pressure of rods, called *spanners*, which, reaching from the deck, are screwed down upon the frame when the boss has entered. The mortice must, of course, be turned upright, either to receive the screw, or permit of its disconnection; the screw being kept upright during these operations by means of a moveable trigger, which is so arranged as to catch the upper blade when necessary. The shaft is made in pieces of about 24 feet in length, which are connected by fastenings called *couplings*.

The after part of the body and fore part of the stern-post are fitted with metal bearings, on which the bosses of the screw rest when it is in place. They are also faced by groovings of metal, which serve to guide the screw during its ascent or descent. These groovings are fitted with metal racks; the screw is suspended in a framing commonly called the *banjo*, from which corresponding pawls project; and which, being permitted to act upon the racks whilst hoisting the screw up, prevent danger in the event of the ropes parting. There is no such provision made for lowering, and therefore great care is taken to attend the falls during that operation.

Tonnage. The common rule for finding the burthen of ships, or what is called the builders' tonnage, is to multiply the length by the extreme breadth, and that product by half the extreme breadth; and then divide the product by 94. The new or Parliamentary rule is more accurate, and may be found in most works on ship building or seamenship. The tonnage of ships is also calculated from the displacement.

Most of the Article on *Construction* is taken from Boyd's Manual. Some of the terms used are different from those used by our ship builders, and the latter generally make a small *model* of the vessel before commencing to build.

Much can be learned by visiting ships in the process of construction, and midshipmen should avail themselves of it.

In the construction of iron-clads many peculiarities occur which can best be learned by *personal observation.*

The "instructor," in teaching ship building, should sketch the ship in the process of building, and point out the connection and uses of the various parts.

QUESTIONS.—What kind of docks were in use at the place you were last stationed?

Did you ever see a vessel docked? If so, tell how it was done, and why it was done.

If a vessel is not coppered, why is it necessary to clean her bottom occasionally, and how is it done?

What is put on to protect the bottom from worms, &c., if not coppered?

What difference does it make whether the vessel lies in salt or fresh water?

How was your vessel taken out of dock?

How is the water pumped out of a dry dock?

How is a ship launched?

ANSWER—[Brady.]

After the carpenters have completed the hull of the vessel, the necessary preparations for launching are commenced as follows:

Get an anchor on each bow; get the cables on board, and bend them to the anchors; range and bitt the cables, bend the buoy-ropes, and see everything clear for letting go the anchors.

It will then be necessary to get four stout hawsers on the spar deck, two on each side; bend one to the other, and have them coiled down clear for running. This being done, pass the ends of two hawsers out forward through the warping-chocks on each bow; pass the ends aft one on each side, and make them fast to some secure place on their respective sides of the launching slip, as clear of the *ways* as possible. Stop the bights of the hawsers with a single rope-yarn up along the ship's sides, so as not to interfere with the ways or interrupt the progress of the carpenters while knocking away the shores previous to launching.

Have men to veer the hawsers and cables when the ship is off the ways, and also to let go the anchors, if necessary.

The ways being well greased, and the preparations for launching completed, all the blocks and wedges by which the ship was formerly supported are driven out from under her keel, until the whole weight gradually subsides upon the sliding ways, or *cradle*; a few *shores* remain, by which she is retained on the *stocks* until the time for launching arrives, which is generally at high water; they are then cut away, and all obstructions removed with the exception of the *dogshore*. When the word is given to *launch*, the dogshore is knocked away, and the cradle, with the vessel on it, slips into the water.

If the ship should *hang* after the dogshore is removed, it will be necessary to apply screws under the *fore foot*, which will cause her to move immediately along the ways. The ways generally extend a sufficient depth under the surface of the water to float the vessel when she arrives at the extreme ends.

When the ship is off the stocks, the hawsers are veered rapidly at first, afterwards slowly, to check her headway. In case of parting the hawsers, let go an anchor.

QUESTION—What timber is used in building our iron-clads?

Name the different kinds of "bolts" in use.

Why are vessels generally launched stern-foremost?

What is a "patent" capstan?

ANSWER—Made on the principle of a "patent sheave." The leaves on the spindle act on cog wheels, which act on an *annular* wheel on the barrel; the spindle and barrel revolve in opposite directions; the former making 1 turn whilst the latter makes 3, affording a gain of 3 to 1. The drum-head is connected with the barrel by moveable bolts, and when these are down the whole machine revolves together as in the case of one of common construction; but when greater power is required, the bolts are withdrawn and the wheel-work thrown into gear. Patent capstans are not in general use in men-of-war.

Describe the steering-gear of this ship, and the ship last served in.

The "instructor" should now point out the following:

The bow; the stern; the cutwater; the taffrail; timber-heads; fashion-pieces; floor-timbers; lower half-cants; futtocks; hooding-ends; top-timbers; transoms; carlins; the fore-foot; the bulwarks; hammock-rail; the hammock-nettings; the quarter-galleries; the bends; bilge; buttocks; counter; heel; hull; and also explain what is meant by sheer; a flat floor; the run of a ship; entrance; hollow lines; dead-rise; deep-waisted; crank; bearings; between decks; bulk-heads; wall-sided; tumbling home; the wake, &c. &c. He will also point out the position and uses of the bumpkins; bill ports; chess-trees; bridle ports; fife rails; topsail-sheet bitts; capstans; wheel and binnacles; pumps; air-ports; scuttle-butt; gallery; coops and pens, &c.; and will explain how the boats are stowed and hoisted; what the "booms" are; what is meant by "gallowses;" the "cat-tail;" the davits; what precautions are used in a 74 when the berth-deck ports are triced up, &c &c.

He will name (say for a 74,) and describe: the spar-deck; the top-gallant fore castle; the poop; the break of the poop; flush-deck; the waist; the gangways; the quarter deck; the main or gun deck; the half deck; the berth or lower-gun deck; the orlop deck; the sick-bay; the manger; the cabin; ward-room; gun-room; steerages; cock-pit; the brig; the state-rooms; the boatswains', gunners', carpenters' and sail-makers' store-room; master's do.; engineer's do.; engine room; fire-room; coal-bunkers; the propeller gallery; the sail room; bread rooms; spirit room; shell room; bolt room; holds; magazines; light room; chain lockers; shot lockers; tiers; bag racks; fore peak; sand locker; the run; the eyes of a vessel, &c. &c.; and should say where and how the men are messed; where the hammocks are hung; where ballast is stowed; also water and provisions of different kinds: such as bread; beef; pork; flour; whiskey; molasses; vinegar; beans; rice; sugar; coffee; tea; cheese, butter, &c. &c.; also, where paints, candles, oil, and master's, pay-master's, engineer's and surgeon's stores are kept or stowed.

The student who has served in other vessels will be expected to answer any questions on any of the foregoing which may be applicable to the ship served in. He must be able to describe the same as located in the school-ship.

All the spars of a ship are either of fir or pine. The smaller kinds are made, when possible, of one stick, and are then called *single-tree*. The larger are composed of several pieces, arranged in various ways, and united by *scarphs*, *cooks* and *iron-hooping*; these are called *made masts*, &c.

The *hoops* of masts are either driven on whilst hot, or else, being made with hinges, are drawn tightly together by screws. Those of the latter kind are called *clasp hoops*.

The hoops are covered on the fore part by a batten called the *rubbing paunch*.

The *hounding* is the length of the mast from heel to the lower part of the head.

The *housing* is the length from heel to upper deck.

The *hounds* and *trestle-trees*, which form the foundation for the *tops*; the chain *necklaces*, to which the topmast rigging is to be secured; the *bolsters*; the *mast-head battens*, the *bowsprit cap* and the *boom-irons* are all fixed in their places in the mast-house. The heels of the main-masts of screw ships are either made open for the passage of the screw shaft, or else fitted with a forked iron *step* in the form of an arch. Very recently, however, the main-mast has been stepped on the orlop deck.

That part of the *bowsprit* which rests upon the stem is called the *bed;* inside of that, the *housing*, and the outer part, the *bee-seating*, or *head*. The bowsprit *cap* is fastened on the bowsprit by an iron plate underneath, and this plate is secured by a bolt, which, being driven through it and the bowspit, is nutted on the upper side of that spar. All the other caps are moveable.

Topmasts are always made in one stick; the only addition being the *hounds*, and the squaring-pieces at the *fid-hole*. The half-dumb sheave below the fid-hole, and the live sheave above it, are cut diagonally through the mast in opposite directions; these are for the top-tackle pendants.

Lower caps were formerly made of elm, but now generally of mahogany; (English) bound with an iron hoop of one-third of their depth. The four eye-bolts for the top-blocks stand athwart-ships on the lower side, and are clenched on

top. The after ones are placed in a line with the middle of the mast-head; the foremost ones in a line with the center of the hole for the topmast.

Bowsprit caps are fitted with eye-bolts for the heel-rope of the *jib-boom*.

Topmast caps have eye-bolts for the top-gallant mast-rope and block.

Yards are made eight square in the middle, and with a shoulder left at the arms for the rigging. The *quarter-irons* of lower yards open on hinges; the outer ones are in one piece. Topsail yards have no quarter-irons, but the arm-irons disconnect.

Lower and topsail yards are iron hooped, with a row of eye-bolts on the upper side for the jack-stay.

The *lower cross-trees*, when in place, fit in scores on the trestle-trees; one abaft the mast-head, and the other before the hole for the topmast. They are secured by saucer-headed bolts, driven through and nutted under the trestle-trees.

Tops are made both whole, and in halves. They are strengthened by upper cross-trees, which stand immediately over the lower ones. The edges are fitted on each side with iron plates for the futtocks, and there is a lubber's hole in the middle.

The *topmast cross-trees* are built and bolted into the trestle-trees, forming but one fitment. The *bolsters* also are nailed on over the necklace before issue.

Fids for top masts and top gallant masts are simply iron or wooden bars thrust edge upwards through the hole in the top mast or top-gallant mast. They should always be secured by laniards, and *this rule is general for all moveable articles used aloft.*

The *heels of top gallant masts* have a sheave for the mast-rope.

The "instructor" should name all the spars of a ship—sketching them on the black-board, or pointing them out in the model—such as:

The fore-mast; the main-mast; the mizen-mast; the bowsprit; the fore, main, and mizen topmasts; the jib-boom; the fore, main and mizen top-gallant masts; the flying jib-boom; the fore, main and mizen royal masts; the fore, main and mi-

zen skysail masts; the spritsail yard, gaffs, or whiskers; the dolphin-striker; the fore yard; the main yard; the cross jack yard; the fore, main and mizen topsail yards; the fore, main and mizen top-gallant yards; the fore, main and mizen royal yards; the fore, main and mizen gaffs; the spanker-boom; the ring-tail boom; the lower boom; the fore and main topmast studding-sail booms; the fore and main top-gallant studding-sail booms; the fore, main and mizen trysail masts, &c. &c.

He should show by a sketch the different parts of a *made mast*, such as: the *spindle;* the *hounds;* the *side-trees;* the *fishes;* the *bibbs;* the *heel;* the *cheeks;* the *chafing paunch;* the *head;* the *tenon*, &c.; and describe the *step;* the *mast-coat*, &c.

He should also sketch the following: the trestle-trees; the bolsters; the lower cross-trees; the tops; the bowsprit; the caps; the topmast cross-trees; the jack, or jack cross-trees; the dolphin-striker; the spritsail yard; the trysail masts; booms and gaffs; the yards, &c.; pointing out the "chocks;" the pigeon holes; the lubber's hole; the top-rim; the scuttles; the bees; the cap-shore; bolts for top pendants and blocks; the jaws; the goose-neck; the yard-arms; the slings; the shoulders, the quarters; the quarter-irons; the boom-irons; the pacific-irons; the paunch-battens; the iron-work on a lower and topsail yard; the common fid and patent fids; saddle for the jib-boom; wythe for flying jib-boom, &c. &c.; and should explain particularly the connection and *use of* each.

He should define the expressions: *rake, sleeve, taunt*, &c.; and tell *why* masts rake, and a sleeve is given to the bowsprit.

The student should be able to tell how all the above are made in the school-ship.

QUESTIONS—What is a 74? a frigate? a line-of-battle ship? a two decker? a three decker? a sloop-of-war? a brig? a brigantine? an hermaphrodite brig? a barque? a schooner? a topsail schooner? a sloop? a lugger? a galliot? a felucca? a polacre?

What is a "dumb" sheave?

A 74, with *three* decks of guns, is called a *two*-decker; can you say why?

CHAPTER V.

RIGGING SHIP.

TO GET ON BOARD AND RIG SHEERS.

Masts are usually taken in at Yards with *standing sheers*; should there be none, however, they must be rigged on board.

Having selected the Spars for the legs, tow them alongside with the heads aft; take two stout hawsers, middle them, pass the bights over the ends of the spar and secure the underneath ends inboard—unship the hammock-rails and reeve the other ends of the hawsers through leading-blocks on the opposite side of the deck. Hang small spars up and down from the channels, to keep the spars clear in coming in. Clap tackles on the hawsers (if necessary) and *parbuckle* the spar up to the rail. Place and secure three or four small spars inboard from the rail, in a slanting direction, to ease the sheers down on, and pass the bight of a small hawser (*counter parbuckle*) from the main-deck ports over each end of the spar for the same purpose, making one end fast and taking a turn with the other; then haul away on the parbuckle and ease away on the counter-parbuckle until the spar is landed. Proceed in the same manner with the other.

Instead of parbuckling, the sheer legs may be gotten in by rigging a small pair of sheers over the taffrail, or bows, and lifting the end of the spar up to the stern, or bow-port, and then clapping on a tackle led along the deck and shifting the sheer tackle lower down.

When in, launch them aft and raise them on the poops or taffrail. Square the heels and cross the heads placing the sheer-head of the side on which the mast is coming in uppermost, and lash them with a round lashing of 4 in., passed on the bight, with six or seven turns on each end, then back again with riding turns—making 23 or 27 turns in all—and knot.

Protect the *sheer-head lashing* carefully with old canvass, where the purchase strap takes, and take a four-fold block, double strapped, for the upper block of the *main purchase*; place it on the fore side of the sheers, middle the lashing,

place the bight of the starboard end over the starboard sheer-head and the bight of the port end over the port sheer-head, then reeve the ends contrary ways through the bights of the strap, pass bight and bight as before, and knot the ends when the lashing is expended.

The upper block of the *small purchase* (an upper jeer-block) is placed on the underneath or after part of the sheers, lashed as the other, but hanging below it; the bights lying on the fore side and across the turns of the main purchase strap.

Lash the upper block of a small tackle to the after leg, above the cross, and a girtline block to the other leg; for canting the mast and other purposes.

Put over the sheer-head *guys*, two forward and two aft; and also the same number of *belly-guys*, upper and lower—all being 7½ or 8 inch hawsers, clove hitched over the heads, or around the legs of the sheers; cleats being driven on to prevent slipping. The pendant tackles may be used for belly-guys.

Reeve the purchases, using a three-fold purchase block and another upper jeer-block for the lower blocks, overhaul the fore-guys and main purchase forward, the former to the cat-heads and the latter toggled through the hole for the bowsprit. Open the sheers out, place the *shoes*, (which are pieces of oak plank hollowed out and long enough to rest upon two beams,) lash the heels to the shoes and pass a bulwark-lashing around the heels and ports next abaft them. Hook a *thwartship tackle* between the heels. If not previously done, *shore* the decks, from the keelsom up, underneath the mast partners. Four large tackles having been provided for *heel tackles*, (two forward and two aft, and hooked to bolts in the shoes,) the forward ones must be hooked aft; man the fore-guys, bring the purchase fall to the capstan, and attend after guys and heel-tackles. Heave round and rase the sheers. When up, haul taut the thwartship tackle and frap it. Hook the forward heel-tackles; transport the sheers aft (wetting the deck) and rake them so that the main purchase will plumb the mast-holes. Haul taut the heel-tackles, set taut all the guys, pass a stout *bulwark-lashing* (cleating the heels of the sheers to prevent its slippling) through the ports, and come up the purchase forward. The heels of the sheers should stand over a beam.

QUESTIONS.—*Show* how parbuckles and counter parbuckles are rove.

What spars would you use for sheer-legs?

Show how the sheer-head lashing is passed.

Show how the main purchase block is strapped and lashed on.

How is the main purchase rove, and what would you use for the fall?

Why should the heels be *squared* before putting on the sheer-head lashing?

Why should not the heels be opened out to their full extent before putting it on?

What are the shoes used for?

Suppose the angle is so small that the main purchase and guys will not raise the sheers; what would you do?

How are the guys set up after the sheers are in position?

What is meant by "shoring" the decks?

Do the lower purchase blocks hook, or toggle?

How are the heels prevented from slipping on the shoes?

ANSWER—By cleats.

Sketch a pair of sheers—showing all the rigging and parts.

TO TAKE IN THE LOWER-MASTS.

The Mizen mast is taken in first for the reason that the breadth of beam increases from aft, and consequently the sheer-head lashing is tautened as the sheers are transported forward; moreover, the foremast can be used in taking in the Bowsprit.

Tow the mast alongside, with the head aft; and the *garland* lashed on the forward side of the mast at a distance from the *tenon* equal to the distance from the *step* to just above the spar-deck *partners;* lash a pair of girtline blocks at the mast-head and reeve girtlines; overhaul the main purchase block down abaft. and toggle it to the garland—securing the toggle by a back-lashing. Put a strap round the head of the mast and hook the small tackle from the sheer-head to it for a *canting tackle*. Take the fall of the purchase to the capstan and heave away; when the heel rises near the rail, hook a *heel tackle* to a strap round the mast near the head to ease it inboard. Point the mast fair for lowering; have car-

penters attending below; wipe the tenon dry and white-lead both it and the step; lower away and step the mast.

The garland is a "warped" strap and is lashed on with well stretched rope; taking jambing turns every six or seven fathoms—or secured with a cross-lashing, which is *backed* by large rope; taking two turns around the mast above the garland and *dogging* the ends around the lashing down towards the heel of the mast. The garland may be cleated to prevent its slipping if preferred. The mast should hang "heel-heavy"

Having stepped the mast, put a couple of straps below the mast-head, hook the pendant tackles to them, wedge the mast temporarily, and steady it by the tackles.

In stepping the mast a Spanish windlass of a capstan-bar may be used to get it on the right slue.

Come up the purchases and bulwark-lashings, wet the decks, man the heel tackles and forward guys, tend the after ones, and transport the sheers forward of the main partners, where secure as before, and proceed to take in the main-mast.

The main-mast is taken in as the mizen-mast, except that the small purchase is also used; the garland being lashed on above the centre of the mast.

Having taken in the main-mast, transport the sheers forward of the fore partners, and take in the fore-mast in the same manner.

Show how a garland is lashed on.

What is meant by "backing" a lashing?

What is "dogging?"

Suppose in lowering the mast, the lower main purchase block comes to the partners before the heel is down to the step?

TO TAKE IN THE BOWSPRIT.

Transport the sheers as far forward as possible, and rake them so that the main purchase block will just clear the partners of the bowsprit—by easing off the after guys—bringing all the forward guys aft and set them up. Lash two large single blocks at the foremast-head, middle a hawser and clove hitch it over the sheer head; take the ends of the

hawser through the blocks, and set them up as far aft as possible. The foremast must be steadied by the pendant-tackles.

Lash the heels of the sheers to the bow ports, and set the heel tackes well taut.

Having put on the bowsprit cap and lashed the garland on so that it will hang a little head-heavy, tow the bowsprit to the bows with the head forward; toggle the main purchase to the garland, and hook the canting tackle to a selvage strap just within the cap; hook *breast-tackles* to eye bolts on each side of the cap, leading to each cat head, and a heel-tackle (or *bedding-tackle*) from in-board through the partners to the heel of the bowsprit.

Bring the purchase fall to the capstan and heave up, directing by the canting tackle and rousing in by the heel-tackle and breast-tackles; white-lead the heel and mortice and rouse it in to its place.

Come up the purchases; take off the breast-tackles, and before unrigging the sheers sway up the jib-boom and place it on the forecastle.

Lower the sheers down, unrig them and launch them overboard.

QUESTIONS—Why is the bowsprit hung head heavy?

How would you take in a bowsprit with two topmasts for sheers?

ANSWER—Strike the fore topmast and hang it with a hawser. Unreeve the pendants from the topmast; unhook the top-tackles; send the eyes of the pendants down abaft the top, hook the top-tackles; hook the lower blocks as far aft as possible—tailing the ends of the falls. Place the spare fore and main topmasts with their heads across the forecastle netting and lash them together; their heels being on each side of the foremast; on the upper sides of these mast-heads lash the two main-top blocks, and on the lower a three-fold purchase block. Send the points of the fore-top pendants down *over* the fore-top, reeve them through the top blocks on the spars and make the ends fast to the foremast head. Reeve a fall through the purchase block; raise the sheers with the fore pendant-tackles; secure the heels; shore up underneath; lash the heels well from forward, &c. &c., as before, and droop the sheers with the top-tackles until the

heads overlook as far from the foreside of the hole as the length of howsing; lash the lower purchase block a little more than half-way out on the bowsprit and put a pendant tackle from the sheer head to the bowsprit cap Let the bowsprit come up, or hang athwart ships, when suspended, so as to clear the figure-head; top or lower at will with the toptacles. The purchase fall should lead to the deck in a line with the sheers.

Show by a sketch how a bowsprit is taken in by the first method—representing the guys, purchases, tackles, &c.

Show the same by the last method.

CUTTING OUT AND FITTING RIGGING.

All rigging may be cut out by scale and compass. For lower rigging: lay off, as two sides of a triangle, the height of the mast from the deck to the bolsters, (plus the fall of the chains if any), and the distance from the centre of the mast-hole to the edge of the chains; the third side—taken as the hypothenus—will give the length of the foremost shrouds, which is also the distance between two posts to be set up for warping off the rigging. To one of these posts secure the end of the shroud hawser and pass it round both posts until the required number of shrouds are wound off; each successive fake lying outside the preceding one, which allows for the rise at the mast-head and the angling of the after shrouds. If from the outside fakes two single shrouds are to be formed (that is, if there is an odd shroud,) it must be increased by the length of an additional eye and a fathom for the splices.

Run a chalk mark right across the upper bights, distant from the post a third of the distance from the deck to the trestle-trees, which, when you fit the rigging, will indicate the termination of the service. This done, cut the bights across at the post where the end is secured, and on the crown of the other bights knot a piece of spun yarn, with an additional knot for each pair of shrouds, for the purpose of distinguishing them. Stretch each length separately and the shrouds are ready for fitting. New rope, before fitting, should be stretched one inch to a foot.

Worm, parcel, and serve the eyes of each pair down to the chalk marks, but continue the foremost shroud on each side the whole way down. Parcel the shrouds in the wake of the

seizing to keep it from sinking between the parts of the service, and seize the eyes, which are from one-fourth to one-sixth larger than the circumference of the lower part of the mast-head; the after leg of each pair being made, before the seizing is passed, a trifle longer than the foremost one.

Having measured the drift for the stays, form a collar the length of the mast-head, by splicing a fork into one end, or by a rope-maker's splice, and marling it down. Form the end of each fork into Flemish eyes and worm, parcel and serve a fathom below the crutch and leather it in addition.

TO CUT FROM A SCALE DRAFT.

It is necessary to have a beam and a fore and aft draft; also a plan of the bows—showing bowsprit, head-booms, whiskers, &c. The former giving the breadth of beam, with channels abreast of each mast, width of tops and topmast cross-trees, &c.; the latter, the length of channels, rake of masts, position of lower and topmast dead-eyes, the bows, cut-water, and all the head booms.

To measure for lower shrouds: Place a mark on the respective mast-head, half its circumference above the bolsters, on the beam draft; measure from this mark to upper edge of the channel; transfer this distance to the fore and aft draft by placing one foot of the dividers on the channel abreast of the forward dead-eye, the other on the mast-head, and dot it, calling it B. This distance increased by the diameter of the shroud, is the length of fore leg of No. 1 pair of shrouds. For after leg of No. 1 pair, measure from B to the upper edge of the channel in the wake of its own dead-eye, increasing it as before by the diameter of the rope. Measure in the same manner for each pair, adding to each leg of No. 2 pair twice the diameter of the rope; to each leg of No. 3 pair, three times the diameter; to No. 4, four times, &c.

For lower stays: measure from the after part of the mast-head to where the stay sets up, adding the length of the mast-head for the collar.

The remainder of the rigging is cut on the same principle. The rigging should be well stretched before cutting, and the diameters to be added to shrouds includes service.

The manner in which stays are *fitted* may modify the manner of measuring them; if fitted with collars and hearts,

measure as above; if the eyes are close, and set up on their ends, allow sufficient for the eye and a few feet (say two) for end, and follow the lead of the stay in measuring for its length.

The Instructor should show practically from a Scale Draft how rigging is measured for.

QUESTIONS—What is a *fake?*

How many shrouds are there on the foremast of a 74? on the mainmast? on the mizen mast?

What is the *crown* of an eye?

Do you parcel with, or against the lay?

Do you serve with, or against the lay?

How are the eyes of the shrouds parcelled, and why?

What is a rope-maker's splice?

ANSWER—The stay, four-stranded, is unlaid, two strands each way; then each half is doubled back and laid up with its own part. At the fork the four strands are worked in as in splicing, tapering off by thinning the strands each time they are put in. The eyes and fork are then served over.

What is the size of lower rigging for the different classes of vessels?

ANSWER—For a 74, 10½ to 11 inch; for a frigate, 9½ to 10; for a sloop of war, 8½ to 9, and so on.

Are the eyes of the shrouds ever parcelled a second time over the service?

In cutting out, *is any allowance made for the eyes?*

Is any allowance made for turning in the dead eyes?

How are the *Mast-head pendants* cut and fitted?

ANSWER—With the long leg (the after one) one-third the length of the shroud, and the short one about the length of the pendant-tackle block shorter. A thimble is spliced into each, and like the eyes of the rigging, they are wormed, parcelled and served. They are fitted in the form of a square; spanned together over the mast-head. If, however, there is but one pendant on each side, they are fitted with a cut-splice.

How are Bobstay and Bowsprit shroud collars fitted?

ANSWER—They are made with lashing eyes; the latter with long and short legs, and if the shroud be chain, with a thimble instead of the heart. The Bobstays are leathered, or served with sennit in the wake of the stem hole, and the collar seizings protected by a bolster.

CHAPTER VI.

RIGGING SHIP.

TO RIG THE BOWSPRIT.

The Bowsprit is filled up at the hole, and thus derives support there from the timbers as the masts do at the partners; but it is also secured by two chain or rope lashings, called *Gammonings*, passed over the fore ends of these filling pieces on top of the bowsprit and through holes in the stem. Chain is now invariably used, but the process of passing and setting up is similar.

The *Saddle* is tarred; the ends of the chain passed over the bowsprit (from the starboard side) through the holes in the stem, and shackled to their own parts; the turns are then passed with the other ends, so that the foremost ones on the bowsprit are the aftermost ones on the stem. [This is called *thoro' putting*]. Each turn is hove taut as it is passed by reeving the gammoning through snatch-blocks made fast to the bobstay holes in the cut-water; bringing the bight through the hawse-hole and toggling on to tackles led from the capstan. Before shifting the tackle each turn is secured by nails driven through the chain into the gammoning fish or saddle, and also by wedges driven into the stem hole. The last are frapping turns passed over some well-greased leather and set up by a tackle on a runner led through a block on the bumpkin.

In *rope gammoning*, "racking turns," with spun yarn, would be used instead of nails, and the general rule is to set up the outer one first. Chain gammonings have been found to stretch considerably after much use, and should, therefore, be considered the first thing when about to set up rigging.

Preparatory to rigging, a *stage* is made of two spars; their heels secured on the head rails and their heads crossed, lashed together and suspended from the bowsprit; a platform of gratings enables the men to rig or "clothe" the bowsprit.

The bowsprit is secured by the bobstays and bowsprit shrouds.

To rig: two-thirds the distance from the knight-heads out lash (or put) on *the collar* (or strap) for the *fore spring stay*, the *inner bobstay collar*, and the *inner bowsprit shroud collar;* once the diameter of the bowsprit farther out the *collar* (or strap) for the *fore stay*, the *middle bobstay collar*, and the *outer bowsprit shroud collar;* and between the Cap and Bees the *outer bobstay collar*.

All the collars are fidded out first, and are then hove taut round the bowsprit by lashings set up with a "Spanish windlass." The stay collars are lashed below, the bobstay collars on top, and the shroud collars on the quarters of the spar, and all are cleated to prevent slipping. They should be lashed on the bowsprit in the mast-house.

When the forestay collars are warped straps the lashing and *heart* is on the upper quarter. In some cases the strap is rove through its own bight without any lashing. The difficulty is to keep them from slewing round; their great utility is neatness, holding less wind, less liable to be shot away, and affording more room for handling the jib-boom. [Generally adopted in the U. S. Navy.]

Bobstays are rove through the holes in the cut-water, middled and spliced—the hearts are seized in with the splice on top, and both parts are seized together at the cut-water—the laniards are set up with a luff upon luff. These, as well as the laniards of stays, are more certain to bear equal strains on all parts if they are set up by both ends at the same time. Bobstays are wormed, parcelled and served; also leathered in the wake of the cut-water.

Bowsprit shrouds are part chain. The outer (rope) part has a heart spliced in to set up to the bowsprit, and is wormed. The inner (chain) part fitted with a hook and thimble.

The *man-ropes* are spliced into eye-bolts on each side of the cap, and set up to the Knight-Heads. After the fore stays are set up these are attached to them by "stirrups."

QUESTIONS—Why is the gammoning thoro' putted?

Recapitulate the *order* in which the rigging is put on the bowsprit.

Sketch the bowsprit and show the rigging.

What sized rope is used for bobstays?

ANSWER—From 8 to 9 inch for a 74; 7 to 8 for a frigate, and so on.

Why are hearts used instead of dead-eyes, in setting up the bobstays and bowsprit shrouds?

Why is the inner fore stay called the spring stay?

Is the storm staysail set on it?

How is a rope gammoning passed?

ANSWER—The standing part of the gammoning is rove with a running eye round the bowsprit, close down in the after part of the saddle, which, with the hole in the cut-water, should be well tarred and greased. A turn is then passed through the fore part of the hole in the cut-water, with the sun, led up and snatched in a large block hooked to a strap around the bowsprit and then down through a leading-block on the deck of a lighter under the bows, and taken to its capstan. When alongside the yard it is generally taken to a capstan on the jetty. This turn is first hove taut, then unsnatched and another turn taken over the bowsprit, before the standing part, down through the cut-water, abaft the other turn, snatched and hove on till the bowsprit is brought down to its mark; looking out for it as each turn is hove taut with a *batten* under the bowsprit to some part of the head. The remaining turns are passed in the same manner, racked and wedged in the cut-water as each is hove down. Nine turns, of 8 inches, is a 74's gammoning. On the last turn being hove taut the frapping turns are passed, commencing above the cut-water and working up, and boused taut with a tackle led along the deck.

To set the gammoning up on board: hook a large snatch-block to a double strap toggled in the port hawse-hole (with right-handed rope) and long enough to reach across the cut-water. Through this lead the gammoning after a turn is taken over the bowsprit, bring it in through the starboard hawse-hole, toggle a tackle to it inboard and lead the fall to the capstan.

With two gammonings the outer one is passed and set up first; otherwise the inner one would be slacked.

Show by a sketch how the above gammoning is passed and set up.

How are the *gob-lines* fitted?

How are the bobstays set up?

ANSWER—If it were possible both ends of the laniard should be set up together, but as this cannot conveniently be done, the next best method is as follows: Make the standing part of the laniard fast with a running eye round the bowsprit close to the collar and reeve as many turns as may be without riding; the object then is to set up in a line with the bobstays. If there is any place on the stem where the lower blocks of the luffs can be hooked to take them there; if not they must either be hooked to straps on the lower parts of the bobstays, or to the hawse-holes. Hook the double blocks below, the single ones to the laniards; lead the falls inboard through blocks on the bowsprit and put pendant tackles upon them. If the laniards are rove with their standing parts on opposite sides alternately, the blocks may be kept clear of each other. When everything has been drawn into its place, shorten up for a final pull and walk all three down together; rack the turns and pass the riders, pulling them up short of cutting into the lower turns, rack these again, half-hitch, seize down, and expend the end.

A shorter way, but not quite so good a one, is to put the single blocks of the pendant tackles on the laniards, hook the doubles at the hawse-holes, lead the falls through blocks on the bowsprit and put tackles on them.

Show by a sketch how the bobstays are set up.

If the bowsprit-cap were not put on before getting the bowsprit in, how would you put it on?

[NOTE.—The Instructor should point out and explain the different methods of rigging the bowsprit, and note the introduction of chain or iron in the fitments.]

TO RIG A LOWER MAST.

The *trussel-trees* are generally put on at the mast-house, but supposing it not done: overhaul the girtlines down from the mast-head, bend on to the *trussel-trees*, sway them on board, and land them forward of the mast; take out the after chock, wipe them dry and white lead the mast-head in their wake; cast off the girtlines and bend them afresh to the forward part, on top, and stop them with several stops to the after part; bend a girtline from forward to keep them clear in going aloft, and a girtline from aft to assist in getting them in place;

sway up, and when above the bibbs, slip or cut the stops in succession, haul aft by the after girtline and get them in the proper place. Send aloft the after chock, ship and bolt it; overhaul down the girtlines, bend on, sway aloft, ship and bolt the *cross-trees*. Then send up the *bolsters*, which are tarred and parcelled, and stop them.

There is no rule as to whether the *tops* go on before or after the rigging. The mast is less disturbed in the partners if the rigging is first put over and steadied up; but the men work better and more safely, fewer things fall from aloft, and the eyes of the rigging are better placed if the tops are put on at once.

Tops are made either in halves or in whole, though half tops are most in use for men-of-war.

To send up a *half top:* say the starboard Main—bring both girtlines to the starboard side of the mast-head; send the *hauling parts* down between the crosstrees, and the *bending ones* abaft the after cross-tree. Lay the half top on deck on the starboard side, a little abaft the mast; top upwards and foremost end forward. Hitch the ends of the girtlines round the middle of the lubber's hole trap and stop them down to the top rim at the futtock-plate hole, abreast the hitch. Lash boards—an ordinary deal will answer—athwart the trestle-trees on their foremost and after parts; drive bolts into these boards in a line with the centre of the mast-head, leaving their upper ends projecting about six inches.

Bend the mizen girtline to the after part of the half-top through one of the stanchion holes. Sway up and guy aft clear of the after cross tree. When the top hangs on the side of the mast head, it is easily placed with reference to its fore and aft position, and on lowering and bearing off the rim the middle parts will bear against the bolts, and the top will fall exactly in its place on the cross-trees.

To send up a whole top: Put the girtlines on each side of the mast head, having the hauling parts between the cross-trees and the bending ends abaft the after cross-tree. Stand the top athwart-ships on the deck, on its after end, having its lower side facing forward, and let it lean with its fore edge against the after part of the mainmast, (supposing it to be a Main Top.) Bend the girtlines on their own sides, by passing them from before the top, and consequently along its

under side through the lubber's hole, through an after futtock-plate hole, so as to keep the top *heaviest on the fore part*, and hitch the ends to their own parts. Stop the girtlines to the fore part of the top through holes made for the purpose; bend the mizen girtlines to the after part through the stanchion holes, guy aft and sway away. When the stops are up to the blocks, the foremost edge of the top will be pointing over the mast-head, and by hauling on the mizen girtlines it will be prevented from tilting aft when the stops are cut; this being done, the girtlines are pulled up, the top falls over the mast-head and is placed on the cross-trees and bolted down; then ship the *top-rail*, and the dead-eyes for topmast rigging.

A mizen top is more easily sent up on the fore side, on account of the aid derived from the use of the main girtlines. Send it up after part uppermost, bending the girtlines to the foremost futtock holes underneath the top, and stopping them at the after part of the top, guying clear with the main girtlines. In short, in sending up whole tops from abaft sling so as to be *top-heavy on the fore part;* in sending down sling so as to be *top-heavy on the after part.* As the mizen generally goes up and comes down *before* all, it must be top heavy on the after part in the former, and on the fore part in the latter case.

To send up the rigging: Shift the girtlines to the after part of the trestle-trees for the rigging. Put a large toggle in the end of each girtline, and bend rounding lines to them. Send up and put over first: the *mast-head pendants;* then the *first pair of starboard shrouds;* the *first pair of port shrouds;* the *second pair of starboard shrouds;* the *second pair of port shrouds,* and so on until all are over; the *lower spring stay* and the *lower stay.*

In rigging a foremast, put on the straps of the clump blocks through which the maintopmast stays reeve, next after the first pair of port shrouds; these straps are fitted with lashing eyes.

In sending up the fore-and-aft stays, the girtlines are shifted to the mast-head.

In sending up shrouds: Seize both parts of a pair together about a quarter down, and put the toggle of the girtline through from inside; stop the girtline at the eye seizing and

at the crown of the eye, which eye is kept open by a piece of spun-yarn from the crown to the seizing. Put a block on the after side of the mast-head and reeve a short girtline to be worked both sides in the top. Sway up and when the eye comes up to the top bend the short girtline under the eye-seizing, stop it up to the crown along the after side, cut the stops of the long girtline and sway over the mast-head. The men aloft break the eye over the mast-head and beat it down in its place. The short girtline must, of course, be *dipped* each time.

After the pendants are put over, the pendant tackles should be hooked to all four of them and eye-bolts at the foot of the mast, and a good up-and-down pull taken to settle them in their places.

Each pair of shrouds should be pulled up and beat down, (putting a junk wad on the part struck,) as they are placed.

The fore stays are lashed with a rose-lashing abaft the mast.

The rigging is next set up temporarily—being turned in with spun-yarn, (the dead-eyes are not turned in at the loft because each leg may stretch differently, and all would have to be turned in afresh to square them,) and both shrouds of a pair, and a pair on each side, are set up together, previously setting taut the fore stays.

Lash the upper blocks of two pendant-tackles—one under the *necklace*, the other about the belly of the mast—take them forward and set them up. These are used to give the mast the forward stay. It is a general rule in staying masts, to set up the fore and aft stays first, but in this case the fore and aft stays are not permanently set up until the shrouds are pulled up and the eyes well beat down and placed; the pendant tackles giving the forward stay.

Having now the mast rigged and the eyes well set down, give the rigging a second and good pull preparatory to *marking off* and turning in the dead-eyes for a full due.

This is done by seizing a sheer-batten along the rigging parallel to the chains, and about three feet from the top of the lower dead-eye, which, if it is well stretched, is a good drift for turning in new rigging. Mark the shrouds and take the batten off. Then measure down a couple of feet on each shroud for half the round of the dead-eye, which mark off for the crown of the bend for turning in, and by strictly ad-

hering to this, you will ensure your rigging being turned in square, and leave the required drift of about three feet from dead-eye to dead-eye.

Do not use parcelling under the throat seizing, for it holds the wet and rots the rope.

Now for a final setting up; come up everything, bring to and steady taut the foremost *swifters;* then knock out all the wedges, (remember that when the mast was gotten in it was wedged *temporarily,*) hook a tackle, luff upon luff, from forward to a strap round the mast close down to the deck, and with it and the pendant-tackles, (steadied forward against a stay tackle from the mast-head aft,) bring the mast to its intended rake. Supposing the mast then to be in all particulars well stayed, drive the wedges in keeping fast the tackles till you have done so—taking care not to alter the position of the mast; and the wedges ought never to be started again except to alter the rake. You may then set up the fore and aft stays, making a small allowance for the mast coming aft as the rigging is pulled up; then set up the after swifters against the stays and the rest of the shrouds in succession, commencing with the foremost pair and setting up a pair on both sides at once. Seize on the sheer poles as soon as the rigging is set up.

The purchase used for setting up lower rigging is a pendant-tackle and a luff. The double block of the pendant-tackle is hooked to the pendant, and the single block hooked to a cats-paw in the hauling part of the luff; the single block of the luff being hooked to a selvagee strap round the shroud, parcelled in the nip, and the double block brought to the laniard. The fore stays are set up in the same manner; the laniard is middled and hitched at the centre round the strap of the heart, three turns are then passed on one end, pulled up, racked, and another turn passed, and so on till rove full, when it is secured; the other end is then cast off and expended in riding turns round the first; each turn being racked and pulled up separately as before.

If the ends are set up on their own parts, a luff upon luff is used.

Main and mizen stays are now usually set up with screws. the ends of stays and rigging are whipped and capped with canvass.

The futtock shrouds (usually iron bars; except the foremost ones, which are of chain,) lead between the legs of the lower shrouds; iron Scotchmen being lashed on the legs of the shrouds to prevent chafe.

[The Instructor should explain the different methods of fitting rigging and placing it over the mast heads; where iron has superseded rope; how often the rigging is set up; the effect produced by running suddenly into a warmer or colder climate; how masts are stayed and the use of *battens;* what rake is usually given and why; difference between standing and running rigging; the *manner of bending a girtline*, whip or ring-rope; whether for sending up cross-trees, mast-head pendants, shrouds, fore-and-aft stays, tops, trestletrees, &c.; or for tricing up to hook a yard-tackle or top block; or for bending a hemp cable or shackling a chain.]

QUESTIONS—What sized rope is used for girtlines?

Sketch a bolster and state its use.

Sketch the trestle-trees and state their use.

Sketch the lower cross-trees and state their use.

Sketch a top and explain its use.

Sketch a cap and explain its use.

Show how the girtlines are bent on for sending up trestle-trees, cross-trees, bolsters, tops, lower pendants, shrouds, and fore-and-aft stays.

What is the use of lower pendants?

Show by a sketch how they are fitted.

Show by a sketch how a lower stay is set up; a pair of shrouds.

What is meant by "drift?"

What is a necklace?

How are futtock shrouds fitted and set up?

How are the dead eyes for the topmast rigging placed?

What are *bentick shrouds?*

What are cat-harpens?

Why is rigging swiftered in?

What is a *sheer-pole* and its use?

What is a *Scotchman?*

What is the number of lower shrouds on the different masts of frigate?

How many mizen stays are there?

How is it fitted and set up?

Give the *lead* of the lower stays.

What are the *swifters?*

Why are the lower stays fitted with lashing eyes, and why put over last?

Recapitulate the *order* in which a lower mast is rigged; commencing with the trestle-trees.

How is the rigging "rattled down."

ANSWER—Rattling stuff should be well stretched before use. The rigging is first sparred down, commencing from below—before sparring, however, the shrouds should be slightly frapped together, and when the rattling is completed the frapping is cut away. Commence with the ratlines from below observing to put them on square. The ratlines are clove-hitched on the outside of the intervening shrouds and seized to the foremost and aftermost but one. An occasional one, a "catch ratline," is carried to the after swifter. Ratlines are placed fifteen inches apart and secured at the ends with nettle stuff.

Show how a ratline is seized on.

[The Student must now explain the manner in which the rigging of the foremast of the School Ship is fitted; how sent down and put over again, &c., &c.

How the tops, trestle-trees, &c., are made; sent down and up; and in short must be able to answer any question from the preceding Article applicable to the School Ship.]

CHAPTER VII.

RIGGING SHIP.

TO GET ON BOARD AND RIG A TOPMAST.

Overhaul down the girtlines, bend on and sway aloft the lower *cap*, which place under side downwards, with the round hole over the square hole in the trestle-trees.

If possible, bring the topmast alongside, so that the hawser may be used in the live sheave without shifting. Lay main topmast in the water on the starboard side. Lash a top-block on starboard side of mainmast head. Take as large a hawser from the capstan through the top block as it will reeve; reeve the end through the mast-hole in the trestle-trees between the stays, and then through the live sheave hole in the topmast, from aft forward, and hitch it securely. Lash the hawser taut up from the hitch round the mast about two-thirds from the heel; hook the pendant tackle of that side to this lashing, and prevent the lashing from slipping by *backing* it from the fid-hole with a stout piece of rope. Heave the mast up with the capstan and pendant tackle, keeping the heel aft, so as to clear the head of the top-rim. Lower it down the main hatchway or scuttle until the head can be pointed through the stays and mast-hole, and land the heel of the mast on the deck, close to the mainmast. Of course, if the topmast is shorter than the distance between the lower side of the trestle-trees and the deck, it may be entered at once, without being lowered down the hatch-way; and when landed, the head must be lashed. Cast the lashings and end of the hawser off, trice its end up with the port girtline through the mast-hole, and hitch it round the mast-head on the port side. Heave up, and when the mast-head is sufficiently through the cap, lash them together. Heave up again, and by means of slue-ropes on the heel, the cap may be

placed on the lower mast-head. Place the *cap-shore*, and as it is liable to work out, secure it with a laniard.

Sway the topmast up the distance of the mast-head above the cap; trice up and hook the top blocks; reeve the pointed end of the port top-pendant through the top block, from aft forward, down between the mast and mast-hole, through or under the dumb sheave, up between the mast and mast-hole again, and half hitch its end in the foremost cap-bolt on starboard side—seizing the end down. To the thimble in the other end of the pendant hook the upper block of the top tackle—the lower block being hooked to an eye-bolt in the deck abreast the mast.

Lash a couple of blocks at the topmast head, reeve girtlines, and with them send up the topmast *cross-trees* (having a guy from the mast-head abaft), which place with the after part, resting on the cap, the forward part against the topmast; secure them to the cap, lower away the topmast until the cross-trees can be placed over the mast-head, then sway up the mast again.

Now come up the hawser and unreeve it (the mast hanging by the port top-pendant), and reeve the starboard top-pendant; hook the starboard top-tackle; man both top-tackles, and sway the mast up to the 'striking mark,' preparatory to rigging. Belay, rack, and coil down both top-tackle falls.

Sway up, place and stop the *bolsters;* put the *necklace* (which is a chain strap having two open link-legs on each side for the *gin blocks* to shackle to,) on the cross-trees, and secure it; put the girtlines on the cross-trees, and place the rigging. Send up first: *the pendants;* then the *first pair of starboard shrouds, first pair of port shrouds,* and so on until all are over; the *breast backstays;* the *standing backstays; the spring stay; the stay;* and (if it be a fore topmast,) the *jib-stay.*

The pendants have but one leg, and are fitted with a cut splice. The shrouds are fitted as the lower ones, and are sent up in the same manner. Breast backstays are fitted with eyes like the shrouds, if there are two on each side; sometimes they are fitted with lashing eyes, and in this case are put over after the standing ones, are sent down in front and sent up and lashed just before leaving. *They are not much used.* The standing backstays are fitted with eyes, if there

are two on each side; otherwise, are fitted with a horse-shoe eye. The fore-and-aft and jib stays are fitted with lashing eyes. The collar of the jib stay is *dipped* below the spring stay before lashing.

Sister blocks are seized in between the foremost shrouds below the seizing for the lift and reef-tackle, in the rigging loft.

The gin blocks should be shackled before setting up the topmast rigging.

Topmast rigging is cut, fitted and turned in with dead-eyes just as the lower. The fore-topmast stays are rove through the bees and set up to the bows through bull's-eyes to their own parts. Sometimes they are carried out so as to act as preventer bowsprit shrouds. The main topmast stays are rove through the clump-blocks at the foremast-head, and set up on deck abaft the mast to their own parts. The mizen topmast stay is rove through a bull's eye, or heart, strapped round the mainmast-head above the rigging, and sets up to its own part. The breast backstays have blocks turned into their ends, and set up with a luff purchase to treble blocks in the chains. The standing backstays have dead-eyes turned into their ends, and are set up by laniards to the channel dead-eyes in the same manner as the lower rigging.

The topmast rigging is cat-harpened in; the cat-harpen legs crossing each other abaft the mast, or fitted thus: the eyes on one end of the cat-harpen leg is seized to the second forward shroud; it is then passed round the mast, and the eye in the other end seized to the second or third shroud on the same side. The *futtock-staves* are seized on on the *inside* of the rigging. The *jib-stay* is rove through its hanks, through the sheave-hole in the boom end, through another in the dolphin striker, and its end, which is pointed and "becketed," set up in the head.

The mast being rigged, hook the upper block of a sail burton to a strap round the mast-head, and carry the lower block forward to be used in staying the mast; hook the top-burtons; man the top-tackle falls, sway up and fid the mast. To get it on the proper slue, or to square the mast, let go one top-tackle and sway up on the other. The upper or lower block of a top-tackle should be a "swivel block."

Steady taut the sail burton, lift the topmast rigging, and

trice it up by a couple of jiggers from the mast-head high up, then place each pair of shrouds, and pull them up separately. Like the lower rigging, they are turned in roughly at first, and when well stretched, turned in and set up for a full due.

Stay the topmast with the topmast stays and standing backstays, and set up the topmast rigging with a top burton and runner; the runner fitted with a selvagee tail on one end, and a thimble in the other; rove through a block strapped with a thimble; the lanyard beat to the thimble with a sheet bend; the tail of the runner clapped on the shroud, and the single block of the burton hooked to the thimble; its double block being hooked to the mast-head pendant; then pull up, beating down with a top-maul.

The stays and backstays are set up with luffs upon luff.

After being set up, the topmast rigging should be *rattled down*, the *sheer-pole* seized on, &c., as the lower rigging.

Send up now and ship the *topmast caps*. This is done by sending down the girtlines from the mast-head as high as possible, hitch the ends to the foremost eye-bolts, seize them to the after ones, and stop them to the fore part of the square hole. When the cap is up to the blocks, bend ropes' ends to its after end; pull down on these as the stops are cut, and the girtlines are pulled up and the cap will find its place.

The *span blocks* are single, hanging one on each side of the fore and main topmast caps for the topmast studding sail halliards; the straps lie on top of the caps, and are seized to the cap bolts on each side. The fore topmast is also fitted with span fiddle blocks in long pendants on each side, for the lower studding sail halliards and boom topping lift. These blocks are sent up before going to sea, and are kept down in port.

In fitting out from the Dock Yard, all spars should be *tried* before stowing them—spare topmasts fidded, cross-trees put on, &c. &c.

[The trussle-trees and cross-trees for topmasts are in one. Instead of a forward chock, a *clamp* is fitted, which can be thrown back when the top-gallant mast is sent up or down.]

[The instructor should now explain the different modes of fitting topmast rigging; putting it over the mast-heads, &c.; the different ways of putting over the cross-trees and topmast cap, &c.]

QUESTIONS—What is a "cap-shore," and its use?

Sketch *cross-trees;* show how they are made, and explain their use.

Show how the girtlines are bent for sending them up.

What is the use of the top burtons?

Show by a sketch how a topmast stay is set up; a backstay; the topmast rigging.

Why is the topmast rigging cat-harpened in?

What is a futtock staff, and why is it seized on *inside* the topmast rigging?

Recapitulate the *order* in which a topmast is rigged.

What is meant by the "striking mark?"

What are the gin-blocks?

What is the size of standing backstays, and why?

Why is the collar of the jib stay "dipped?,'

Why are breast backstays put over before the standing ones, if used?

[The student must now tell the manner in which the foretopmast of the School Ship is rigged; how the mast is sent down and up, cap put on, &c. &c., and be able to answer any question from the preceding article applicable to the School Ship.]

TO RIG A JIB-BOOM.

Point the jib boom through the cap-hole, using a whip on the fore stay; reeve the heel-rope through a block at the cap, inside the stays, through the sheave hole in the heel of the boom, and hitch the end to the other cap-bolt. Put on first: the *traveller;* then the *foot-ropes*, the *martingale*, the *guys*, and the *wythe for the flying jib-boom.* The *dolphin striker* is slung near the cap; and the *spritsail gaffs* near the rigging by "jaw-ropes," and supported at their ends by lifts from the bowsprit cap.

Travellers are rarely used. The *foot-ropes* are fitted with a cut splice, an overhand knot, or a cuckold's neck, over the boom end; have overhand knots taken every four or five feet, to prevent slipping on them, and are set up to bolts in the

cap; and to give a better stand, are stopped a foot or two down the guys. The *martingale* is fitted with an eye over the boom and dolphin striker ends. The *guys* are fitted with an eye over the boom and spritsail gaff ends. They are sometimes fitted in pairs.

Before sending out the jib-boom, make fast the jib halliards to the outer end of the boom, haul it taut, man the heel-rope and rig out—easing the jib halliards. When out, the "heel chain" is scored in the heel, the "crupper chain" is scored in the notch, and both are secured by *slips*.

The *spritsail gaffs* are rigged as follows: over the end, first the *jib guy*, then the *gaff guy*, the *jumper*, the *lift*, and through a hole in the end, the *flying jib guy*. The *gaff guy* sets up with a thimble and laniard to a bolt in the bows; the *jumper* to a bolt in the cutwater; the *lift* to a bolt in the cap; the *flying jib guy* to a bolt in the bows.

The fore guy of the lower boom sometimes reeves through a block on the gaff end.

The *dolphin striker* is rigged by putting a gromet over the end; then the *gob-lines* or *back-ropes*—fitted with a cuckold's neck, and setting up to the bows; after which the *jib martingale* and *flying-jib martingale*.

The *jib stay*, the *fore top-gallant stag*, the *flying jib stay*, and the *fore royal stay* are rove through sheave holes in it, and set up to the bows.

Set up the back-ropes, gaff-guys and jumpers (which operation sets up the jib guys and martingale), and take off the jib halliards from the end of the boom.

Spritsail yards were formerly used and carried out under the bowsprit end; they were afterwards, and are now sometimes in large ships, carried across the knight heads. *Spritsail gaffs* are, however, most in use. Small vessels, such as brigs, have *whiskers*, which are iron out-riggers projecting from the cat-heads.

Many ships carry a netting from jib-boom end to spritsail gaff, to catch a man in case of his being thrown off the boom.

[The instructor, as before, to explain different modes of rigging jib-booms; explain *use* of the dolphin striker and spritsail yard, gaffs, or whiskers, the traveller, &c. &c.]

QUESTIONS—What is the *saddle* of the jib-boom?

Explain the use of the guys; the martingale; the jumper; the back-ropes.

How is the "heel chain" fitted," and what is its use?

What is the "crupper chain," and its use?

Why are they fitted with "slips?"

Recapitulate the *order* in which the rigging is put on the jib-boom; the spritsail gaff; and the dolphin striker.

What is the size of jib guys?

What is a jackstay used for on a jib-boom?

ANSWER—For the men to hold on by. It goes with an eye over the boom end, and sets up to the cap.

How are the martingale and guys set up?

CHAPTER VIII.

RIGGING SHIP.

TO GET ON BOARD AND RIG A LOWER YARD.

The yard being towed alongside with the opposite yard arm forward, overhaul down from the lower mast-head a large hawser, bend it to the slings, and lash it in several places towards the forward yard-arm; take the hawser to the capstan, and heave the yard up and down [fenders being hung up and down the side of the ship]; put a large strap on each quarter about one-fourth out to the yard arm, overhaul down and hook the pendant tackles to them—cut or slip the lashings in succession; hauling on the lower pendant tackle and easing away the other until the yard is square athwart-ships; land it on chocks in the nettings, and lash it.

To rig the yard. The *sling-bands*, of iron, are put on the centre of the yard before launching. Lash on the *quarter blocks* on either side of the sling-band, directly under the yard. They are double strapped, stand athwart-ships, and lash on top of the yard, and are spanned together; on the span is seized a small double block for the *slab lines*.

Next to the quarter blocks are placed the *trusses* and their *straps*. Each truss pendant goes round the yard with a running eye, leads round the mast, through the thimble in the truss strap on the opposite side, and up into the top; where a single block being turned in its end, it is set up with a fall through it, and a double one at the cap—the fall leading on deck. The truss straps are double, and the thimble stands up and down.

Patent *iron trusses* are used for all yards but the fore and main of ships-of-the-line.

A little outside the trusses, seize on the *clew-garnet blocks*—single strapped, standing athwart-ships, and lashed on top of the yard. Just outside of the block, put a *strap* and *thimble* for the standing part of the clew-garnet.

The *rolling tackle strap* is generally a gromet; a thimble is seized in it, and it is then driven taut up on the quarter.

The *burton strap* is also a gromet, with a thimble seized in it on top; it is about two-thirds out from the slings.

Jackstays (*reefing and bending,*) go on first over the yard-arms; the eye-bolts on the yard are served with rope yarns, and the upper eyes of the *stirrup* are then placed over them; the jackstays are then rove through the eye-bolts, and set up to each other in the bunt of the yard.

The *head earing strop and thimble* is next put on. Then the *foot-ropes*, which, after being rove through the stirrups, are secured abaft the yard in the bunt. Large ships have *Flemish horses* on the lower yards.

The eye of the foot-rope should be put over the yard-arm in such a manner that the rope will lay abaft and well up.

Next to the foot-ropes are put on the *straps for the yard tackles*, having thimbles seized into them, which hang under the yard. (Not much used, however, in American ships.)

Then the *brace blocks*. The yard-arm straps are single; those on the blocks are double, so that the blocks may be horizonta'. The straps are connected by lock-thimbles.

Lastly, the *lift blocks*, which are single and single strapped.

The *leach-line blocks* are seized to the jackstay for a full due; when on bending sails their proper position is determined.

The *lower yard slings* should now be sent aloft: they are chain straps around the lower mast-head, to which the yards are hung with a slip shackle. The after parts are cleated up clear of the rigging eyes, and the foremost hang down through holes cut in the fore part of the top amidships, before the foremast cross-tree. In the English Navy *sling-bands* are not used for large ships; the *slings* used are double chain straps, which being passed around the yards, between the jeer straps, are rove through their own bight. There are large links in the upper bights, through which, when the yards are up in their places, the tongues of the mast-head sling slips are passed and secured.

Send aloft the *jeer blocks;* these are double and treble, according to size of ship; double strapped with lashing eyes; which, after passing through holes in the tops, are secured abaft the lower mast-head.

Reeve the jeers and lash the lower blocks to the quarters of the yards. English men-of-war lash the leaver blocks on the yards, and keep them there. They are single or double, double strapped, having long and short legs; stand fore-and-aft on top of the yards, and the straps are secured on the fore quarters of the slings of the yards with rose lashings inside the quarter blocks. After the lower yards are up, short jeer falls are rove and racked, and act as preventer slings.

American men-of-war do not *carry* their jeers aloft. *Preventer slings* are sent up when necessary.

Jeers are not allowed small vessels—the pendant tackles answering the purpose.

The braces and lifts having been rove, hook a tackle from forward to a strap round the slings of the yard, to keep it clear of the mast when going up; take the jeers to the capstan, man the lifts, tend the fore-and-aft tackles and braces, and heave the yard up. When up, connect the slings, reeve the trusses, walk back the jeers, and, when the slings have got the weight, unreeve the falls. Square the yard by the lifts and braces. It is a good plan to assist the jeers with the top burtons.

The *cross-jack yard* has *sling band; quarter blocks; single truss; rolling tackle straps; foot ropes; brace blocks* and single *lifts*. The brace blocks are hooked to an iron band one-sixth of the distance in from the yard-arm. The lifts go over the yard-arm with an eye. Clew-garnet blocks, burton straps, jack-stays, head-earing straps, yard tackle straps, leech-line and slab-line blocks are dispensed with.

[A single block for the reef pendant is sometimes put over the fore and main yard-arms next the foot-ropes; otherwise it is fitted with lashing eyes, and is sent down when the sails are unbent in port.]

[Iron has taken the place of rope in so many of the fitments of lower yards, and the yards of different classes of vessels are rigged so differently, that no invariable *rule* can be given. The preceding applies to a 74. The instructor should explain to the student the various methods of getting lower yards on board; the fitting of slings, both on the yard and over the mast-head; the jeers; the quarter blocks when iron bands are used; how patent iron trusses are

made, and their advantage; different ways of putting on stirrups; what a D-thimble is, and how put on, &c. &c.; and should point out the *use* of the slings, trusses, quarter blocks, slabline blocks, clew-garnet blocks and straps, rolling tackle and burton straps, the jackstays, stirrups, head-earing strap and how fitted, foot-ropes, yard-tackle strap, and why it is not much used; what is substituted for it, and how English men-of-war have their yard-tackle pendants fitted; leech-line, brace and lift blocks; jeer blocks and falls, &c. &c. He should also require the student to describe the rigging of the fore yard of the School Ship; how everything is fitted, and how the yard is sent up and down.]

QUESTIONS.—How are fore braces rove?

ANSWER—Standing part to head of mainmast under the trestle-trees, through block on the yard, through blocks on mainmast under the trestle-trees, down through leaders in the main fife-rail.

How are main braces rove?

ANSWER—Standing part with a running eye over the bumpkin, through block on yard, through block on bumpkin, and in through a sheave in the side.

How are cross-jack braces rove?

ANSWER—Standing part to after main swifter, through block on yard, through block on main swifter, down on deck.

What are preventer braces?

How would you reeve a new brace by the old one?

How are the main lifts rove?

ANSWER—Standing part over the yard-arm with a running eye, through the after sheave of the block at the cap, through the block on the yard, through the other sheave of the block at the cap, down on deck. If the lift is double, the standing part is at the cap.

How are the jeer falls rove?

ANSWER—Standing part round the yard or to a strap on the yard, through the blocks at the mast-head and on the yard alternately, and down on deck. The fall sometimes goes through a hole in the spar deck, and is brought to the main deck capstan.

In heaving up a lower yard, why should it be kept square?

What is to be apprehended if the jeers are hove "two blocks?"

Recapitulate the *order* in which a fore or main yard is rigged; a cross-jack yard.

Sketch a yard with its rigging.

Sketch a "patent truss;" a rolling tackle strap; a burton strap; a head earing strap; quarter blocks; slings; brace blocks; jeer purchases; treble, double and single lifts; fore, main and cross-jack braces, &c. &c.

Why are the thimbles through which the trusses reeve double strapped?

How would you bend on the girtlines for sending up a jeer block?

NOTE.—In getting a lower yard on board, hook a tackle from forward to a strap on the forward yard-arm, and bend a rope's end from forward, outside, to the after yard-arm; the first to be used to ease the yard-arm aft; the second to assist in laying it square across the nettings.

TO GET ON BOARD AND RIG A TOPSAIL YARD.

Tow the yard alongside with the opposite yard-arm forward, and hoist it in as the lower yard. Land it on chocks in the gangway for rigging.

Leather the yard in the slings, and lash on the *tye-blocks*. In large ships there are two, and they are lashed on as near the centre of the yard as possible; they stand with their sheaves fore-and-aft, on the top of the yard; they are double strapped, and the bights of the straps are seized together on the forward part of the yard.

If iron is used, there are two iron bands on the yard to which iron-bound *swivel tye-blocks* are connected by a bolt and forelock.

Next the *parral*, which is made of two pieces of rope, wormed, parcelled and served; one piece being longer than the other; the four ends have eyes spliced in; the short leg is placed on top of the long one—its ends being equally distant from those of the other. They are then marled together, covered with leather, and seized together at the short

ends. The *parral*, when in use, is placed abaft the mast with the seam of the leather outside; the long ends are passed round the yards from underneath, and are lashed to the short ones. One side of the *parral* is lashed on the yard on deck; the other after crossing.

Next the *quarter blocks;* these are double, and are single strapped. They are lashed on under the yard; lashing on top, and stand athwart-ships.

Rolling tackle strap next, as on the lower yard.

Burton strap, as on the lower yard.

On the yard arm: put over first, the *jackstay*, then the *head earing strap and thimble*, and then the foot-ropes. The jackstay and head earing strap fitted as for the lower yard. The foot-ropes are put over the yard-arm as for a lower yard, and are then set up to the opposite quarter of the yard. They should be taken *abaft the topmast*, marled together there, and covered with leather. Thus fitted, they act as a *preventer parral.*

The *Flemish horse* is a yard-arm foot-rope, reaching from the neck of the boom-iron to the outer quarter of the yard. They are put on *after* the lift.

The *brace block straps*, which go on next the foot-ropes, are double; so also are the straps on the blocks; consequently, the blocks stand edgeways.

The *lifts* are last put over the yard-arm with an eye. They lead through the lower sheave in the sister block in the topmast rigging, and set up in the top.

The *mizen topsail yard* has but one *tye-block*, or one iron band; a single *parral;* and no *burton strap;* the *flemish horse* is spliced into an eye-bolt at the yard-arm, and the brace blocks face forward.

The yards being now ready for swaying aloft, overhaul down two hawsers; rove through single blocks at the topmast head; bend one to the slings, and stop it out to the forward or upper yard-arm; reeve the other through one of the tye-blocks, and carry the end to the topmast head and hitch it. Sway the yard up and down, and rig the yard-arms (*i. e.*, put over the brace blocks and lifts); the upper yard-arm is rigged aloft, the lower one on deck; reeve the braces and lifts; sway aloft, cast off the stops as required, and take through the slack of the lower lift as the yard rises. When high enough,

hook the burton to the lower strap, cast off the quarter stop, and cross the yard by the burton and lower lift. Square the yard by the lifts and braces, secure the parral, and reeve the *tyes*.

The tyes are rove through the *gin-blocks* at the topmast head, from aft forward, down through the *tye-blocks* on the yard, from aft forward, and the ends secured around the topmast head with a round turn and two half hitches (or sometimes to a link attached to an iron band across the topmast head, under the rigging). The other ends of the tyes have a thimble spliced in, to which are hooked the upper blocks of the *topsail halliards*, called the *fly-blocks*.

The *topsail halliards* are a luff purchase; the lower block is hooked to a bolt in the channels, through which and the upper or fly-block the fall is rove alternately. The standing part being at the lower or single block. The mizen topsail tye is single; rove through a sheave in the topmast, and hooked to a band on the yard. One pair of halliards as above.

[The instructor should point out where and how iron has taken the place of rope; the different methods of fitting tye-blocks and reeving tyes; parrals; the use of *jaws* on topsail yards, and what parral is used with them; foot-ropes, &c. &c.; and should explain the *use* of the tyes, halliards, parral, quarter blocks, rolling tackle and burton straps, jackstay, foot-ropes; why taken abaft the topmast, and why foot-ropes of the top-gallant, royal and lower yards are *not* so taken; flemish horse, &c. &c.; and should require the student to describe the rigging of the topsail yard of the School Ship, how every thing is fitted, and how the yard is sent up and down. He should also now lecture on the comparative size of rigging for different classes of vessels.

QUESTION—How are fore topsail braces rove?

ANSWER—Standing part at main topmast head, down through block on the yard, through leading blocks at the fork of the main stay, through others under the main trestle-trees, and down through leaders in the main fife-rail.

How are main topsail braces rove?

ANSWER—Standing part at mizen topmast head, down

through block on the yard, through span blocks on the mizen mast about half way up, and down through sheaves in the mizen topsail sheet bitts.

How are mizen topsail braces rove?

ANSWER—Standing part at main cap, through block on yard, back through block at cap, and down through a leading block abreast main rigging.

Recapitulate the *order* in which a fore or main topsail yard is rigged; a mizen topsail yard.

Sketch a yard with its rigging.

Sketch a parral; a brace block and strap.

Why are the quarter blocks double?

What is a *pacific iron?*

How many sheaves are there in a topsail yard, and what used for?

Show by a sketch how the tyes and halliards are rove; the lifts and braces.

What prevents the fly-block from catching under the top when the halliards are let go?

ANSWER—The fly-block is fitted with a *traveller*, and travels on a *travelling back-stay*, which is seized to one of the standing ones

How would you cross the topsail yards—using the sail burtons and long tye?

ANSWER—It is customary, now-a-days, to cut one of the tyes long enough to use in sending the topsail yard up or down—such being the case, lay the main topsail yard on the starboard side of the deck, with its port yard-arm forward; the fore and mizen on the port side, with the starboard yard-arms forward. The foremost yard-arms will thus be the upper ones. Hook the sail burtons to the straps on the upper quarters of the yard; round the long tye halliards close up, and hitch the ends of their ties taut through the tye-block next the lower yard-arm.

Let the sail burtons and tyes be outside the lower stays, and in the case of the main outside the fore brace. Take the boom irons off, and have chocks fitted for the lower yard-arm irons to step in. Lead the sail burton falls on the main deck. Sway up and down, bearing the lower yard-arms amidships as the upper ones rise from the deck; and the latter will clear the top. When up and down, bear the lower yard-arms for-

ward, that the men in the tops may work close to the upper yard-arm; put on the brace blocks, lifts, flemish horse, jewel blocks and boom irons; the lower lifts should be tailed with a piece of strong rope long enough to lead inboard a couple of fathoms through a block in the chains: sway away. When the slings of the yards are just above the lower caps, if the upper yard-arms are clear of the cross-trees, ease up the sail burton, pull up the lower lifts, gather down the braces, and square the yards; tautening the fore and main braces. Parral the yards. Reeve the short tyes, make them fast, haul them taut and belay; then let go the long tyes, round up their fly-blocks, carry their ends to the mast-heads, square the fly-blocks, and secure the standing parts of the long tyes by passing the *bights* round the mast-heads; seizing them to their own parts; then clinch their ends round the standing parts, ready for shifting yards, taking care that when the bights are cast off and the clinches run down to the tye-blocks, there will be drift enough for pulling up the long tye halliards.

The weight of topsail yards is always kept off the caps by keeping the lifts at a certain length; consequently, the halliards should always be kept taut when the yards are down—especially when reefing or furling.

QUESTION—What is a sail burton?

What are the boom irons?

What are jewel blocks?

What is meant by "*drift* enough?"

NOTE.—All fitments, such as boom-irons, &c. &c., should be tried on the spare yards before the latter are stowed.

It is customary for men-of-war to shift topsail yards for exercise. I have seen a French frigate commence with her top sails and top-gallant sails set. In *eight minutes* from the time of starting the top-gallant sheets, the topsail yards were on deck; in *ten minutes* thereafter the new yards were up, sails bent, and topsails and top-gallant sails set.

Her topsail brace blocks and lifts *hooked*, however, which facilitated the rigging of the yard-arms. The yards were handled by the burtons alone.

CHAPTER IX.

RIGGING SHIP.

SENDING UP AND RIGGING A TOP GALLANT AND ROYAL MAST.

Sway the mast on board and lay it on the deck abreast the mast, heel aft.

Send up and place on the topmast cap the *jack cross-trees* or *jack*. It is of iron, having an iron cylinder called a *funnel*, connected with it to support the eyes of the rigging; it is covered with tarred parcelling, and has a gromet around it to supply the place of bolsters.

Send up the top gallant rigging and place it over the funnel; put over first the *fore and aft stay*, then the *starboard shrouds*, the *port shrouds*, the *breast backstays*, and the *standing backstays*. [If it be a *fore* top-gallant mast put over the *flying-jib-stay* and *flying-jib halliard block* next the fore and aft stay.

Then send up the royal rigging and place it in the same order, on top of the funnel, with the top gallant rigging—first a gromet, then: the *fore and aft stay*, the *starboard shrouds* the *port shrouds*, the *breast backstay* and the *standing backstay*. Put on top of all, the *truck*, with the *lightning conductor* attached.

The fore and aft and flying jib stays go with an eye splice over the funnel. There are a pair of shrouds on each side for the top-gallant masts, fitted as the lower or topmast shrouds. [Line-of-battle ships have three shrouds on each side, in which case the odd ones go with a cut splice.] The top gallant shrouds lead through holes, or over scores in the horns of the cross-trees, between the topmast shrouds, above the futtock staff, and down into the top—where they set up through bull's-eyes to their own parts. Sometimes their ends are connected in the tops with a long splice and a double block seized in the bight, through which, and a single one at the top-rim, a tackle is rove and the shrouds set up.

Breast backstays are not much used. If fitted, however,

there is one on each side, fitted with a cut splice—a single block is spliced in the end through which, and another single block in the channels, a fall is rove, by which to set them up.

There is one standing backstay on each side; they are fitted with a horse-shoe and set up through bull's eyes to their own parts.

The royal rigging is fitted in like manner.

Ships of the line have two royal shrouds; other ships but one. In the latter case, the royal shroud and breast backstay are fitted together. The shroud leads through the jack and down to the top-rim; where it either sets up through a thimble to its own part, or has a single block spliced in its end and sets up with a fall rove through it and another at the top-rim.

Breast backstays are hardly ever used, but if so, are fitted with a cut splice or with the royal shroud, and set up as the top-gallant ones.

The standing backstays are fitted and set up as the top gallant.

The top-gallant shrouds and royal ones also, have a thimble seized in below the eye seizing for the top-gallant and royal lifts.

The fore top gallant stay is rove through the outer sheave in the jib-boom, through a sheave in the dolphin-striker, and sets up to the bows. The main leads through a sheave or chock in the after part of the fore topmast cross-trees and sets up in the fore top. The mizen leads through a bull's eye at the main cap and sets up in the main top.

The fore royal stay is rove through the outer sheave in the flying jib boom and sets up to a bolt in the bows. The main leads through a thimble in the gromet over the fore top gallant mast-head and sets up in the fore top. The mizen leads through a sheave, or thimble, at the main topmast cross-trees, or cap, and sets up in the main top.

Having sent all the rigging aloft, reeve the top gallant mast rope from the deck through the lubber's hole, through the block at the topmast cap, through the mast holes, down before all on that side of the lower stay on which the top-gallant mast is; reeve it then through the *lizard*, downwards through the sheave hole, take two half-hitches with the end of the lizard through the royal sheave hole; send the end of the mast rope up on the same side of the stay, through the mast-hole, and

make it fast to the foremost bolt in the topmast cap on the opposite side. Or if the mast rope is not long enough to admit of the end being carried aloft, clove-hitch it over the top-gallant mast head and mast-rope, and put a good *racking* round both parts of the rope above the sheave-hole. Sway the mast up, cast off the lizard when the mast-head has entered the mast-hole, (carry the end of the mast-rope up to the cap, if not done already, and cut the racking,) ship the truck, reeve signal halliards, sway the mast and place the royal rigging; reeving royal yard—rope and lifts; sway higher, and place the funnel with the top-gallant rigging, observing to keep the mast on the right slue, reeve the top-gallant yard rope and lifts—lash the span blocks for top-gallant studding sail halliards, sway up and fid the masts.

Stay the mast with the fore and aft stays and standing backstays, and set up the shrouds.

[The span blocks for the top-gallant studding sail halliards are generally sent down in port.

The *clamps* in the topmast trestle-trees are thrown back when sending up the top-gallant mast and clamped again when it is up.]

QUESTIONS—Of what use are the jacks?

Recapitulate the *order* in which a top-gallant mast is rigged; a royal mast.

What is a lightning conductor, and how fitted?

If breast-backstays are used, how is greater spread given them?

ANSWER—By *outriggers* from the tops for topmast backstays, and from the cross-trees for the others.

Why are the fore and aft stays first put over?

Why are breast backstays of but little use? and what stay supports the mast mostly?

What is a "lizard?"

Show by a sketch how the standing backstays are set up.

How is the fore top-gallant mast of the School Ship rigged and how sent up and down?

What is meant by a "short top-gallant mast rope?"

What is *housing* top-gallant masts?

How are the top-gallant shrouds fitted as to worming, parcelling, &c.

ANSWER—The eyes are wormed, parcelled and served and

the swifters served their whole length. They are also well served from above the holes in the cross-trees to below the futtock staff. The general rule is to swerve in the work of all *nips*, and wherever *chafing* is to be apprehended.

What composes the *chafing gear* used aloft?

Is the top gallant rigging rattled down?

ANSWER—In large ships it is, (unless Jacob's ladders are used,) but not in smaller ones.

How are the Jacob's ladders fitted if used?

How is the flying-jib stay rove?

ANSWER—Through the inner sheave in the flying-jib boom, through a sheave in the dolphin striker, and sets up to the bows.

TO RIG A FLYING-JIB BOOM.

The flying-jib boom should be gotten out before the fore top gallant mast is fidded; though in men-of war the masts and boom are, in point of fact, fidded and gotten out together.

Hoist the boom in and point it over the bowsprit; reeve a *heel rope* through a block at the jib-boom end, bend it to the heel of the flying jib boom, and stop it along to the outer end. Have *slip-ropes* from the jib boom and sway out. The *wythe* is previously shipped on the jib boom end; it is of iron; the square part being fitted on the end of the jib boom and the round part through which the flying-jib boom passes on the starboard side. Sway out on the heel-rope, and when the end of the boom is pointed through the wythe, put on the rigging: first the *foot-ropes;* then the *martingale;* lastly, the *guys*. Reeve the flying-jib stay through the inner and the fore royal stay through the outer sheave hole.

The foot-ropes go over with a cut-splice or cuckold's-neck, and set up to the jib-boom end.

The martingale goes up with an eye over the boom end, reeves through the dolphin striker, and sets up to the bows. There is one guy on each side; they are fitted with a cut-splice over the boom end, reeve through a hole in the sprit-sail gaff, or through a thimble double strapped there, and set up to the bows on either side.

Man the heel-rope, rig out the boom, and set up the martingale and guys. The heel of the boom rests against the bowsprit cap and is lashed to the jib boom.

QUESTIONS.—What are "slip-ropes?"

What is the *use* of the *wythe?* the foot-ropes? the martingale? the guys?

Why are the thimbles on the spritsail gaffs double strapped?

Recapitulate the *order* in which the rigging is put over the boom-end.

TRYSAIL MASTS.

All *ships* have a main and mizen trysail mast, and some have a fore.

Brigs have no main: some have a fore.

They are coppered for the greater part down the after sides, have hoops for the sails rove on them, and are stepped with their heads through a hole in the top. The heel rests either on the deck, in a crutch on the mast hoops, or on the fife rail.

QUESTIONS.—What is the *use* of a trysail mast?

What has taken the place of trysail masts?

CHAPTER X.

RIGGING SHIP.

TO RIG AND CROSS A TOP-GALLANT YARD.

Hoist the yard on board and place it on deck. There is but little *rope* used on a top-gallant yard.

It is rigged as follows: first the *sling-band;* then the *parral*, and next the *quarter blocks*. The *sling-band* is an iron band round the centre of the yard, with an eye on top, to which the yard rope hooks. The *parrel* is fitted with a long strap on one quarter of the yard, and a short strap on the other, seized close to the yard, and covered with leather. The *quarter blocks* are double, single strapped, with lashing eyes; or else they hook to an iron band on the yard.

About one-third out towards the yard-arm, put on a *single strap and thimble* for the *lizard*.

On the yard arm: put over the *jackstay*, *head-earing strap and thimble and foot-ropes*. The jackstay is almost invariably of iron; otherwise it is fitted as on the topsail yard. The head-earing strap and thimble is fitted as on the topsail yard. The foot-ropes are fitted like those on the topsail yard, but are not taken abaft the mast.

Lastly, the *brace and lift*, the eyes of which are marled together. The top-gallant braces of large vessels are double; in which case, there is a block on the yard.

The lifts are rove through the thimbles, which were seized into the top-gallant shrouds below the seizing, and lead into the top.

The *snorter* is spliced into an eye-bolt in the end of the yard, and is stopped towards the slings.

[The brace and lift are not put on until the yard is *aloft*, and go *over* the snorter.]

To send the yard up. The yard-rope has a pair of sister-hooks spliced into the end, which hook to the sling-band.

There is a *gromet* on it large enough to go over the yard arm; also a thimble, round which the *lizard* is spliced. Reeve the yard-rope through the sheave in the top-gallant masthead from forward aft, overhaul the end down on deck abaft the top, or through the lubber's hole, and take it through a leading block; hook the sister-hooks to the sling-band, put the gromet over the yard-arm, and reeve the lizard through the upper strap on the quarter of the yard, and hitch it to the slings. Man the yard-rope; send men aloft to receive the yard: one man on the topmast cross-trees to put on the upper lift and brace, one on the topmast rigging to put on the lower lift and brace, one on the topmast cap to pass the parral lashing, and a man on the topsail yard to bear the yard clear. The lifts and braces having been sent aloft and rove, sway the yard aloft, and when the upper yard-arm is clear of the cross-trees, avast swaying; the man there takes off the gromet and rigs the upper yard-arm; sway higher, and when the slings are a little above the topmast cap, avast swaying; rig the lower yard-arm, and take a turn with the parral lashing. Man the lower lift, tend the upper one, the braces and lizard. At the command "sway across," the man on the cap lets go the lizard, the lower lift is pulled up, and the yard crossed. Square it by the lifts and braces, and finish securing the parral. Haul up the yard-rope, and coil it away in the top.

The fore top-gallant brace is rove through a block secured to the forward shrouds of the main topmast rigging, near the eye seizing, and down through a leading block in the main fife-rail. The main leads to the mizen topmast rigging in the same manner, and the mizen to the main again.

Instead of double braces for large ships, it is better to splice a block in the lower end and reeve a whip.

[Harbor Routine, p. 27.]

QUESTIONS—Why are the quarter blocks double?
Sketch the yard and rigging.
Sketch a parral.
Recapitulate the *order* in which the yard is rigged.
How many sheaves has a top-gallant yard?
Why is it handier for the quarter blocks to *hook?*
What is a "lizard," and its use?
What is a "snorter," and its use?

Formerly "jack blocks" were used in sending up and down the yards; what were they, and how used?

What is a "tripping line?"

Where are the top-gallant and royal yards kept when down?

ANSWER—The fore and mizen top-gallant yards on the port side, the main on the starboard side, in the lower rigging; the fore and mizen royal yards on the starboard side, the main on the port side, also in the rigging.

Are "jaws" ever put on top-gallant yards?

ANSWER—Very much used; they keep the yards steady when the ship is rolling, but are in the way when sending the yards up and down.

How are the yards hoisted when setting the sails?

ANSWER—By the *halliards*. The yard-rope having been hauled up and coiled away in the top, the upper block of a luff tackle is toggled to it at the cross-trees, the lower block is hooked to a bolt in the top, and the fall sent through the lubber's hole on deck; this is called the *halliards*. If more purchase is wanted, as it is in large ships, a single block is put on the yard rope, and a runner rove through it; one end of the runner is hooked in the top, the other has a thimble in it, to which the double block of the luff is hooked.

Sketch "halliards" fitted as above.

How is the top-gallant yard of the School Ship rigged and sent up?

Give the analogy between "trusses" and "parrals;" "slings," "tyes," "yard-ropes" and "halliards."

How is a top-gallant yard sent down?

ANSWER—Take off the halliards and send the yard-rope down on deck; overhaul a little of it, and stop it out on the opposite side to that on which the yard is coming down; this is done by reeving the lizard through the thimble of the quarter strap and hitching it; bend the *tripping line* to the snorter, and send it down on deck forward of the topsail and lower yards, and take it through a leading block. Sway up on the yard-rope, pull up on the lift on the side on which the yard-rope is stopped out and let go the other one, and haul

down on the tripping line; at the same time letting go the parral. Lower away; the tripping line and snorter will pull off the lower lift and brace, and the upper one will slip off as the yard is lowered. When the yard is down, stop in the lifts and braces. [Harbor Routine, p. 28.]

The braces must be tended at the command to "sway."

If the running gear had been previously rove, it must, of course, be unrove.

[The *commands* for performing the evolution will be found in the "Harbor Routine.]

How are the yards secured in the rigging?

Are the yards sent up before or abaft the lower and top-sail yards?

How are the lifts and braces stopped in?

What is meant by "tending" a brace?

TO RIG AND CROSS A ROYAL YARD.

The *sling band* is the same as on a top-gallant yard; the *parral* also; the *quarter blocks* are single. Put on a *quarter strap for the lizard;* and on the yard-arm: the *jackstay* [though it is now generally of iron,] and *foot-ropes*, and splice the *head-earing strap* to the eye of the latter; the *brace* and *lift* as on a top-gallant yard, and lastly the *snorter*.

The lifts reeve through the thimbles in the royal rigging, and lead into the tops. The fore royal braces lead to the main top-gallant mast-head; the main to the mizen top-gallant mast-head, and the mizen to the main topmast cross-trees.

The yard is sent up and down like a top-gallant yard, and is placed in the rigging on the opposite sides. In rigging it aloft, one man stands on the jack, another on the cross-trees.

QUESTIONS—Why are the quarter blocks single?

How are the yards hoisted when the sails are set?

ANSWER—By the *halliards*. The yard rope leads down abaft, and the double block of a small luff is hooked to a strap on it some distance up, and the lower block to a bolt in the waterways. The fall is taken through a leader.

Sometimes a single block is toggled to the yard rope, well up, the end of the yard rope rove through a block in the water-ways, and then through the block on the yard-rope.

In small vessels, the yard-rope is generally shifted to windward in fresh winds.

The halliards are taken off when about to send the yard down.

Sketch halliards fitted as above

What are "checking" lines?

CHAPTER XI.

RIGGING SHIP.

TO GET ON BOARD, SHIP AND RIG A SPANKER BOOM.

The spanker boom is hoisted in with the yard and stay tackle and launched aft over the taffrail. To rig it: Put over the outer end the *foot-ropes;* these are fitted with a cut splice; the inner ends are set up to the boom, with a rose lashing inside the taffrail. Next the *guys and sheets*, which are fitted in one; the standing part goes over the end of the boom, as the guy, and it is then rove alternately through a double block at the quarter, and a single block on the boom, as the sheet.

The *topping-lifts* are rove through cheek blocks at the mizen mast head, one on either side, and hook to a bend round the boom; in the lower end a double block is turned, through which, and a single block at the foot of the mizen mast, a fall is rove.

Sometimes there is but one topping-lift, in which case it is rove through a sheave in the gaff, through a block at the top-mast head, down on deck.

QUESTIONS—How is the inner end of the boom secured? What are the guys and sheets for? the topping lifts? Show by a sketch how the boom appears when rigged.

TO RIG A GAFF.

The *vangs* are fitted with a cuckold's neck, or clove hitch, near the end of the gaff, and have a single block in their ends, through which, and another at the quarter, a whip is rove. There is one on either side.

The outer *peak halliard* block is put on the gaff one-third of its length from the outer end, the inner one two-thirds; the straps of these are fitted around the gaffs gromet fashion, or with lashing eyes. They are kept in their places by cleats. The double block for the peak halliards is strapped

to a bolt in the after part of the mizen cap; the halliards are rove up through this, in through the blocks on the gaff, the inner one first, and the standing part secured to the block at the cap, the fall leading on deck.

The upper block of the *throat halliards* is secured under the top and the lower block is hooked to an eye-bolt in the gaff on the *jaws;* the straps of these blocks are leathered.

Seize two pair of small span-blocks on the gaff for the *peak brails*, as the luchline blocks of a course, so that the after leech of the sail may be hauled up taut along the gaff; two triple blocks are strapped, one on each side, to the eye-bolts under the jaws of the gaff for the throat brails and for leaders to the peak brails.

Fit a small double block, for the *ensign halliards*, to an eye-bolt driven in the end of the gaff.

Fit the *jaw-rope* with its rollers to the gaff.

Having rove the throat and peak halliards, hoist up the gaff a sufficient height to secure the jaws to the trysail mast by the jaw-rope; reeve the ensign halliards, hoist up the gaff to its place and steady it by the vangs.

Gaffs for the fore and main trysails are rigged in the same manner.

QUESTIONS—What are the vangs, and their use?

What are the throat and peak halliards, and their use?

Sketch a gaff, showing the rigging.

How is the gaff of the School Ship rigged?

Gaffs are now usually suspended by *spans;* how are they fitted, and how is the gaff sent up and down when suspended in this way?

What is the jaw-rope?

Name the parts of a gaff.

In a schooner the standing part of the peak halliards should be *inside*, can you say why?

LOWER BOOMS.

The lower, or swinging booms, have *goose-necks* fitted on one end, which hook to the foremost part of the fore chains to iron straps. They are towed alongside and gotten in their places with a burton from the foremost shroud and another on the after backstay.

The rigging is hooked to an iron band, one-third the distance in from the outer end.

The *topping-lift* is hooked to this band and rove through a clump block at the lower cap, (or through a block seized to the fore shrouds, well up,) down on deck. A *lizard* is spliced around a thimble on the topping lift to use when getting the boom out.

The *forward guy* is double; the standing part is made fast to the spritsail gaff, rove through a single block on the boom, through another on the spritsail gaff, through one at the bowsprit cap, in on the fore castle.

The *after guy* is also double; the standing part is hooked to a bolt in the side, rove through the block on the boom, back through a sheave in the ship's side.

Jacob's ladders and *pendants* are also fitted for the men to get in and out of the boats, and for the boats to ride by.

To get the lower boom out: Carry the lizard out to the yard-arm and secure it; man the topping lift and forward guy, top up and haul forward the guy, slacking the after one. Trice the boom by the fore yard.

[Harbor Routine, page 21.]

QUESTIONS—What is the lower boom used for at sea, and in port?

In what other way is the topping lift fitted?

What is the use of the lizard?

How are the pendants fitted?

How is the boom gotten alongside?

What is done with it when the lower studding sail is not set at sea?

STUDDING SAIL BOOMS.

The rigging of a topmast studding sail boom consists of a single block for the *lower studding sail halliards*, another for the *topmast studding sail tack*, a *brace* and a *topping lift*. The blocks are strapped around the end of the boom and are kept in place with a bolt running through their straps and the boom; the brace goes with an eye over the boom end, and leads through a block at the main rigging, or has a single block spliced in its end, through which a whip is rove.

The topping lift leads through the span fiddle block at the

topmast head, down on deck. The length of the boom is half that of the lower yard.

A whip is hooked to the inner end of the boom to trice it up with.

A top gallant studding sail boom has only one block at the outer end for the *tack:* no brace or topping lift.

The *tricing line* is single.

To send a studding sail boom aloft: Overhaul down the fore clew-jiggers, (the upper blocks being made fast under the tops at the boom jigger holes,) cross them, and bend on to the inner ends of the topmast studding sail booms. Bend the topmast studding sail halliards on the outer ends about eight or ten feet from those ends. Trice up, and the booms will lie along the lower yards: and if the points are outside of the outer irons a pull on the clew jiggers will bring them in, whilst a pull on the halliards will land them on the inner irons, upon which they may be rigged out. When the booms are in place, clamp the irons and secure the heels.

These booms are triced up by a tricing line; the inner irons being first unclamped.

Send the ends of the topsail buntlines down before all and bend them to the heel lashings of the top gallant studding sail booms. Mark these booms in the middle with a notch or copper nail. Splice a small piece of rope into the jack-stay on the topsail yard, half the length of the boom from the yard-arm iron. Trice up and pass the end of the rope round the boom; haul it out, and lower until the mark is at the place where the rope is made fast. Take a turn with the rope *over* the yard, lower the buntline and the boom will pivot horizontal, and may be entered in the iron without trouble.

These booms may also be sent up by slinging them with spans and using jiggers on the lifts.

Booms are rigged out and in by jiggers, and secured by *Heel lashings.*

QUESTIONS—*How* are the studding-sail booms secured on the yards, and how rigged out and in?

How are the booms sent up and down in the Practice Ship?

Name all the studding sail booms and tell their use.

In what other way may the booms be sent up?

BLACKING DOWN.

When the rigging is in its place advantage is taken of a warm day to rub it down with a mixture of two parts of vegetable to one of mineral tar. The thinner, or rather the hotter it is the better.

Thin tar, lamp-black, hot salt water, whiskey, and a little litharge is generally used.

The top gallant masts should be sent down, leaving the rigging aloft—the men who ride down and black the topmast stays, can black the top gallant and royal stays at the same time—or the men at the mast-heads can haul them over, black them, and pay them over when done.

Previous to blacking down, the awnings should be furled, (if set,) hammock cloths hauled over, decks sanded, and paint work protected with old canvas.

[See "Harbor Routine," page 20.]

TO SHIP AND UNSHIP A RUDDER.

Hang the rudder to a scow, and bring it under the stern. Bore a hole through the beam over the *rudder-case*, drive an eye-bolt up through it and fit a *washer and forelock;* hook a top block to this bolt, and reeve a top pendant through it, through the rudder-case, and hitch it to the tiller hole. Clap a deck tackle on the other end of the pendant; have *heel-ropes* leading forward on each side, after being rove through their respective holes in the rudder. Man the deck tackle and hoist away. When the rudder is high enough, guy it fair with the heel-ropes, see the *pintles* fair for entering the *gudgeons*, lower away and fit in the *wood-lock*. Come up the pendant and unreeve the heel-ropes; take the bolt from the rudder-head, (if used,) also the one from the beam. Ship the *tiller* and reeve the *wheel ropes*. Stop the *Rudder chains* up under the quarter, and put the *Relieving Tackles* in place. Some rudders weigh as much as ten tons; in handling them the bolts overhead should be clinched, or fitted as above.

When a ship is ashore, or when shipping the spar tiller at sea, the *rudder-chocks* should be driven in.

To unship the rudder: Reeve the pendant as before; if the rudder is very heavy double it. Put a buoy and a buoy-

rope on the rudder from the outside. Lash the spanker boom down; put a tackle on it from the mizen mast-head for a preventer lift and pull it and the topping lifts taut; lead a hawser through a block at the mizen mast head, through another on the boom at the lifts, and put a running eye on the end, with a slip stop rope on the eye.

Lift the rudder, taking out the wood-lock, fish the heel of the rudder with the hawser, and when it has caught below the lower pintle, heave the heel up, lowering the head, until both are nearly awash. Place the boats on each side of the rudder, lash spars across their gunwales, chock the spars up from the keelsons and thwarts, and hang the rudder to them by slip fastenings, remembering that the head is considerably the heaviest part.

If it has to be sent into very shoal water, put in on a raft of casks.

QUESTIONS—Will a rudder float?
What is a rudder-case?
What is a washer and forelock?
What is the tiller and its use?
What are rudder-chocks?
What are the pintles and gudgeons?
What is the wood-lock?
What are the rudder chains and their use?
How are the wheel-ropes rove?

ANSWER—The standing part is clinched, or hitched, to a bolt in the side, abreast the tiller-head; rove through the block on the tiller-head, back through a block hooked near the standing part, and led over rollers to the *pipe* under the wheel, up through the pipe, and three and a-half turns taken round the barrel of the *wheel;* an eye in the end, which is put over a staple and a toggle put in.

Sometimes both wheel-ropes are in one, in which case the rope is middled and seized to a staple on the barrel of the wheel and the ends rove as before

In reeving wheel ropes, the tiller should be exactly amidships so that an equal quantity is taken up on each side.

What is used for wheel-ropes?

ANSWER—In Men-of-War, *Hide Rope.* In steamers, iron rods and chain.

Why is iron always used in River Steamers?

ANSWER—One reason is, that in case of fire the boat is generally run ashore, and if the wheel-ropes were of rope, and were *burnt*, the boat would be unmanageable.

What angle is allowed the rudder either way?

ANSWER—From 35 to 40 degrees is considered enough.

What are the Relieving Tackles?

ANSWER—In case of parting the wheel-ropes, the relieving tackles are hooked, and the ship steered by them until new wheel-ropes can be rove.

They are simply luffs; the double blocks are kept hooked to a bolt in the side, near the blocks for the wheel ropes, the falls kept clear and the single blocks ready for hooking to a bolt or strap on the tiller head. When used, the single blocks are hooked and the falls manned.

If the tiller is carried away, how is the ship steered?

ANSWER—By luffs, clapped on the rudder-chains until the spare tiller is shipped. Some vessels have a permanent tiller on the after part of the rudder, for use in this case. When the tiller is abaft, or when a *yoke* is used, what was *starboard* becomes *port*, and the reverse.

Show by a sketch how wheel-ropes are rove.

Describe the steering-gear of this ship, or the ship last served in.

What is a Yoke?

If the Wheel-Ropes are too slack, how are they set up?

CHAPTER XII.

RIGGING SHIP.

RUNNING RIGGING.

The *jib* is seized to the *hanks* on the jib stay, or is laced to the stay; (the lacing being passed *against* the lay of the stay;) the luff is kept down by the *tack*, the sail is hoisted by the *halliards*, haul aft by the *sheets*, hauled down by the *down-haul*, and brailed up by the *brails*.

The hanks, if used, are put on the jib stay before it is rove through the sheave-hole in the jib-boom; the *tack* is a small piece of rope spliced into the cringle at the foot of the luff of the sail, and is rove through a thimble dogged on the stay close down to the boom and through the cringle alternately until turns enough are taken. The standing part of the *halliards* is made fast at the collar of the jib stay, rove through a block on the head of the sail, up through a block under the fore topmast trestle-trees, and down on deck on the starboard side. The *sheets* are double whips, with pendants, which are made with an eye in the bight that is connected with the clew by a strap and toggle. The *down-haul* is bent to the head of the sail, rove through the hanks about one third down, through a block at the jib-boom end, in on the fore castle. The *brails* are bent to the leach of the sail, rove through blocks on the luff, through blocks at the jib-boom end, in on the fore castle.

The *flying-jib* is bent to *hanks*, and has *tack*, *halliards*, *sheets* and *down-haul*. The *halliards* are single and lead through a block at the fore top-gallant mast head. The *sheets* are also single and lead through thimbles on the spritsail gaffs, in on deck. The *down-haul* leads through a block at the flying-jib-boom end.

The *fore-topmast staysail* is bent to *hanks* on the spring stay. The *tack* is secured as for the jibs; the *halliards* rove as jib halliards, but head down on the port side; the *sheets* are also similar; the *down-haul* is bent on as for the jib, is rove through a block at the bowsprit end, in on deck.

The *fore storm staysail* is fitted with *gromets*, or *beckets*, to a stay of its own, which either toggles through the collar of the forestay, or is lashed around the foremast head with lashing eyes, and leads through a bull's eye strapped on the bowsprit; the stay is set up to its own part. It is sent down in fine weather.

The *tack* is secured to the strap of the bull's eye; the *halliards* are simply a luff tackle; the double block being hooked to a strap round the mast-head, and the single one to the sail. The *sheets* are luff tackles with the hooks well moused. The *down-haul* is bent and rove as the others, and leads through a block on the bowsprit, in on deck.

The other staysails are the *main;* the *main topmasts;* the *middle;* the *main top-gallant;* the *mizen*, and the *mizen topmast.* They are fitted on the spring stays, or on stays of their own, with *hanks*, and have *tacks, halliards, sheets, down-hauls* and *brails*, but are not much used.

The *courses* are bent to the yards with *head earings* and *robands.* The *head earing* is spliced into the cringle; two turns are taken through the head earing strop on the yard and the cringle, and the rest expended round the yard and through the cringle. The *robands* are secured to the jackstay.

The sail is set with the *tacks, sheets* and *bow-lines.* A piece of iron, called the *spectacle* is put in the clew, and to this the tack and sheet blocks, shackle and the clew-garnet blocks are seized.

The *fore-tack:* standing part over the bumpkin, with a running eye, through the block at the clew of the sail, down through a block strapped on the bumpkin, in through a hole in the bows on the fore castle.

The *main tack:* standing part hooked to a bolt in the gangway, through the block at the clew of the sail, down through a block hooked near the standing part.

The *fore sheet:* standing part hooked to a bolt in the side of the ship abaft the fore channels, through the block in the clew of the sail, and down through a sheave in the side.

The *main sheet:* is rove in a corresponding manner.

The *fore bow-line:* standing part has an eye to slip over the toggle in the bow-line bridle, leads through a block on the fore stay collar, in on deck.

The *main bow-line:* is a whip and runner. One end of

the runner is secured near the foot of the foremast after being rove through a thimble in the bow-line bridle—in the other end is a single block through which a whip is rove. To unreeve the main bow-line let go the standing part of the runner.

The courses are taken with *clew-garnets, buntlines, leechlines* and *clew-jiggers.*

The *fore clew garnets:* standing part secured to a strap at the quarter of the yard (or to the yard) through the secret block in the clew of the sail, up through the clew garnet block on the yard down on deck.

Main clew garnets: are rove as the fore.

The *fore buntlines* are rove through double blocks under the forward part of the fore top, down forward of the sail and toggle to the foot. The hauling parts lead through blocks at the fore fiferail. There are two on each side.

Main buntlines: the ends are rove through a shoe block and then through a double block under the forward part of the main top, from forward aft, and go down forward of the sail and toggle to the foot. In the other sheave of the shoe block another rope is rove; the standing part of which is made fast at the foot of the main stay and the hauling part leads through a block at the same place.

Fore and main leechlines: there are two forward and two after leechlines on each side. They are rove through blocks under the forward or after side of the tops, through the blocks seized to the jackstays and are clinched to the cringles. The blocks are so placed on the yards that when the sail is hauled up the leach of the sail is hauled taut along the yard from the yard arm.

The *slablines* are bent to the middle of a span at the foot of the sail and lead up abaft through a block at the slings of the yard down on deck. Their principal use is to lift the foot of the sails, the foresail particularly, in light airs or calms.

The *clew-jiggers* are the same as those for the topsail, and only used in port.

The *courses are reefed* by means of the *reef pendants, reef earings* and *reef points.*

The *reef pendants* are rove through blocks at the yard arms and are clinched to the cringles in the leach of the

sail; in the other end is spliced a thimble to which the clew-jiggers are hooked when about to haul out for reefing. When not in use the pendants are stopped along the yards to the jackstays.

The *reef earings* are spliced into the cringles in the leach of the sail; when reefing take two turns over a hook on the yard-arm, and through the cringle and expend the end over the yard and threugh the cringle from forward, aft; hitch the end to the lift.

The *reef points* are put through the eyelet holes in the sail, from aft forward, and a line is run abaft through the bights, both legs are forward, and in reefing are hitched around the jackstay. The sail hangs in a bight abaft the yard.

Sometimes but one point is used.

The *topsails* are bent to the yards as the courses were; *head-earings* and *robands* passed in the same manner.

The *sail is set* by the *halliards, sheets* and *bowlines.*

The *halliards* have been described.

The *sheets:* standing part clinched with an inside clinch to the yard-arm, through the block in the clew of the sail, through the sheave in the yard, in through the quarter blocks, and down on deck through the topsail sheet bitts. The mizen topsail sheets are single and are hooked with sister hooks to the clew of the sail and lead as before.

The *fore top bowlines* are toggled to the bowline bridles and lead through blocks at the bowsprit cap, in on deck.

The *main top bowlines* lead through blocks under the fore top, down on deck.

The *mizen top bowlines* lead through blocks seized to the after main swifters, down on deck.

The *topsails are taken in* with *clew-lines, buntlines* and *clew-jiggers;* the *halliards* being lowered.

The *clew-lines:* standing part hitched to the yard, or around the strap of the quarter block, through the block in the clew of the sail, up through the forward sheave in the quarter block, down on deck. They are sometimes rove single, and have a single block spliced in the end through which a whip is rove.

The *buntlines* are toggled to the foot of the sails, rove through the *spars,* through blocks, or cheeks, at the topmast heads, and down on deck. The object of the span is to girt

the foot of the sail amidships when the yard is down and buntlines hauled up. Not used in port.

The *clew-jiggers* are gun tackle whips; the lower blocks strapped with a long leg which hooks to the clew of the sail; the upper blocks are hooked at the topmast heads. They are put on forward of the sails and are only used in port; are unhooked at sea. The *halliards* have been described.

The *topsails are reefed* by means of the *reef tackle, earings* and *reef-points*.

The *reef tackle:* a pendant is rove through the sheave in the yard and clinched to the cringle; the inner end has a thimble in the end to which a luff or burton is hooked, the double block being hooked to the topmast cap and the fall leading on deck; or, the standing part is clinched to the neck of the boom iron, rove through a block at the cringle, up through the sheave in the yard, through the upper sheave in the sister block in the topmast rigging, down on deck.

The *reef earings* are spliced into the cringles, and are passed as explained in "Harbor Routine," page 55. The close reef earing should be passed from aft forward, and the after reef points hauled well up to bring the sail on the after part of the yard. This rule is not, however, universally followed.

Instead of splicing the earings into the cringles, it is better to work an eyelet-hole below the cringle and splice the earing in it. In this way the cringles are gotten well up on the yard.

The *reef points* are put through the eyelet-holes and stitched. The after legs are longest.

The *top gallant sails* are bent to the yards as the topsails and courses are.

The *sail is set* by the *halliards, sheets* and *bowlines*.

The *halliards* have been described.

The *sheets:* are single; hooked with sister hooks to the clew of the sail, rove through the sheave in the yard, in through the after sheave in the quarter blocks, down on deck.

The *fore top gallant bowlines* lead through blocks on the jib-boom end, in on deck.

The *main top gallant bowlines* lead through sheaves in the after part of the fore topmast cross-trees, down on deck.

The *mizen top gallant bowlines* lead through blocks at the main cap.

The *top gallant sails are taken in* with *clew-lines* and *buntlines;* the *halliards* being lowered.

The *clew-lines* are bent to the clews, rove through the forward sheave in the quarter blocks, down on deck.

The *buntlines* are spliced around a thimble travelling on a *span* at the foot of the sail, lead up through blocks at the top gallant mast-head, down on deck.

The *top gallant sails* have sometimes a reef band, but are almost never reefed.

The *royals* are bent as the top gallant sails. They are set by the *halliards, sheets* and *bowlines.*

The *halliards* have been described.

The *sheets* are bent to the clews, lead through the sheaves in the yard, through the after sheave in the quarter blocks, down on deck.

The *fore royal bow lines* are rove through blocks at the flying jib-boom end, in on the fore castle.

The *main royal bowlines* lead through chocks at the fore topmast head, down on deck.

The *mizen royal bowlines* lead in like manner to the main topmast head.

All *bowlines* are toggled to the bridles.

The royals are taken in by *clewlines;* the *halliards* being lowered, the *clewlines* are bent to the clews, lead through the quarter blocks, down on deck.

Skysails and *moonsails* are set above royals, but are seldom used in men-of-war.

The *spanker* is bent to the *hoops* on the trysail mast; lead to the gaff, or bend to hoops on it; and confined to it by the *throat* and *peak earings;* the luff is kept down by the *tack.* The *throat earing* is generally called the *nock earing.*

The *nock earing* is either passed through an eye-bolt in the jaws of the gaff, or is bolted there. The *peak earing* is passed over a cleat on the gaff end, and then through the cringle, and round the gaff. If the sail brails in along the gaff, which is now generally the case, there is no peak earing. The *tack* is a small jigger hooked to a strap around the goose-neck.

Trysail masts are now usually dispensed with. The luff

of the spanker has iron toggles in it, which travel up and down an iron groove fitted to the lower mast, and the gaff is not lowered to bend or unbend the sail. It has no *jaws*, but is hooked to an iron band.

The *spanker is reefed* with lashings through the cringles, and reef-points knotted on the foot-rope.

The spanker is set by the *outhaul*.

Spanker outhaul: standing part clinched around the boom end, through the block in the clew of the sail, through a sheave in the boom, in on the poop.

If the sail travels on the gaff, there is a *peak outhaul* which hooks with sister hooks to the head earing cringle, reeves through a sheave in the gaff end, through a block under the mizen top, down on deck.

The spanker is taken in with the *brails*, or, if it comes in along the gaff with *brails*, *downhaul* and *clew-rope*.

The *peak brails* are middled, seized to the leach rope, and rove through the blocks on the gaff, through blocks at the jaws, down on deck; one on each side.

The *throat brails* are middled, seized to the leach of the sail, rove through blocks at the jaws, down on deck; one on each side.

The *middle brails* are seized as before, and rove through blocks on the luff of the sail; one on each side.

The *foot brails* are rove in the same manner. All brails are so seized on as to bring the leach taut in along gaff, up to the jaws, and in to the mast.

The *downhaul* is hooked, or bent to the head of the sail, rove through a few hoops, through a block at the jaws, down on deck.

The *clew-rope* is bent to the clew, leads through a block at the jaws, down on deck.

Gaffs are also fitted with *cheeks* instead of blocks, and sheaves are sometimes cut in the jaws for the brails.

The *main trysail* is bent and reefed as a spanker, and almost invariably is fitted to run in along the gaff.

The sail is set with the *peak outhaul* and the *sheet*, which is a luff; the double block hooked to the clew, and the single one to a bolt in the deck. The sail is taken in as a spanker, with gear rove in similar manner.

Fore trysails are bent, set and taken in as the main; they are generally dispensed with now-a-days.

It must be observed that if the trysails and spanker are fitted to brail in along the gaff to the mast, that the peak halliards must be dispensed with and the gaffs hung with *spans*.

The fore storm staysail, fore topmast staysail, jib and flying jib are called the *head sails*.

The head sails, staysails, trysails and spanker are called *fore and aft sails*.

The courses, topsails, top-gallant sails, royals, skysails and moonsails are called *square sails*. A ship, by the wind, with the head sails, square sails and spanker set, is said to be *under all plain sails*.

The sails not yet mentioned are the *steering sails*, or *studding sails*, as now generally written.

The *lower studding sail*. The outer half of the head of the sail is bent or laced to a yard. The *earings* are passed through holes in the yard for the outer turns, and then round the yard and through the cringle; the roping is kept up next the yard.

All studding sails are bent in the same manner. The topmast and top-gallant studding sail yards are the length of the head of the sail.

The *lower studding sail is set* by the *outer halliards, the inner halliards*, the *sheets*, and the *outhaul*.

The *outer halliards* are bent to the yard with a studding sail bend, lead up *before* the topmast studding sail boom, through the block on the boom end, through the fiddle block at the topmast head, down on deck.

The *inner halliards* are light gun tackle whips; the upper block at the fore top-rim, the lower one hooked to the inner head cringle. The fore clew-jiggers are frequently used for the purpose.

The *sheets* are middled and seized to the inner clew. When the sail is set, one end is rove through a thimble strapped on the lower boom, to trim down the sail with; the other is led over the hammock netting for use in taking the sail in.

The *outhaul* is bent to the outer clew, rove through a block on the outer end of the boom, and aft through a sheave in the side, in the gangway.

The sail is set from the deck, and after being cut adrift, a

strap is put round the body of the sail and the yard, and a toggle put through. A tripping line is bent to the toggle [called a *squilgee*,] and led on deck. The squilgee is hauled out when the sail is half way up.

The *lower studding sail is taken in* with the *clew-line* and *sheet*.

The *clew-line* is bent to the outer clew, led through a block at the inner end of the yard, through a block at the top-rim, down on deck. It is abaft the sail and fore yard.

The *sheet* as before described.

The lower studding sail frequently has a reef-band in it running from the inner clew to a certain distance above the outer clew, or tack; to use in case the lower booms are topped very high up. It is seldom used.

The studding sail gear of the fore yard is gathered up to its quarters on each side by whips called *gear tricing lines*. The bights are stopped snug along the yard, and the ends taut up and down the fore rigging.

The *fore topmast studding sails* are bend to the yards with *earings* and *lacings* [or spun yarn]. The sail is set by the *halliards*, *tack*, and *short sheet*.

The *halliards* are bent to the yard, led up forward of the topsail yard, through the jewel blocks at the topsail yard-arms, through the span blocks at the topmast cap, down on deck.

The *tack* is bent to the outer clew, rove through a block at the boom end, and aft through a block on the forward main snifter.

The *short sheet* is bent to the inner clew of the sail, and when the sail is set, is rove through a thimble on the fore yard and into the top. Its use is to trim down the sail.

The *sail is taken in* with the *downhaul* and *long sheet*.

The *downhaul* is bent to the outer yard-arm, and leads through a cringle in the leach of the sail, through a block seized to the outer clew (or tack), down on deck, forward of the fore yard.

The *long sheet* leads from the inner clew down on deck. It is in one with the short sheet. After the sail is set, the tack and long sheet have to be hauled up and sent down forward of the fore yard.

Main topmast studding sails have the same gear as the fore, but are not much used.

Topmast studding sails have a reef band to take in a reef when set with reefed topsails. They are set from the deck, either using a *squilgee* as for the lower studding sail, or are secured with two yarn stops, which are cut in succession by a man on the lower yard as the sail goes over the brace block. The outer stop is taken round the halliards and yard to keep the latter up and down as it goes up.

The *top-gallant studding sails* are bent as the topmast.

They are set by *halliards, tacks* and *sheets.*

The halliards are bent to the yards, lead up, forward of the top-gallant yard, through the jewel blocks, through span blocks at the top-gallant mast-head, down on deck.

The *tack* is bent to the outer clew, leads through a block at the boom end, down to the after rim of the top.

The *sheet* is bent to the inner clew and leads into the top, where it is trimmed down.

They are taken in by the *sheets* and *tripping lines.*

The *sheets*, as just described.

The *tripping lines* are bent to the inner yard-arm ends, and lead into the top.

They are set from the tops, being kept up and down the forward topmast swifter.

No studding sails are set on the mizen mast, and generally only top-gallant studding sails on the main mast.

In making up a lower studding sail, sheets are furled in the sail. The outer halliards and other gear triced up.

The topmast studding sail halliards are hitched to the clew of the topsail when the sail is in.

The tack and boom-brace are triced up, and the downhaul and sheets rolled up in the sail.

The halliards and tacks of the top-gallant studding sails are generally kept bent.

When about to send down the top-gallant yards, the jewel blocks must be taken off the yard-arms.

Royal studding sails have the gear, and are set and taken in as the top-gallant. They are only used in large ships, and not always in them.

QUESTIONS.—If the jib is laced, why is the lacing passed against the lay of the stay?

Of what use are the jib-brails, and what is the objection to them?

In bending sails, what are the *outer* turns taken with the head earings for?

What is the difference in reefing a course and reefing a topsail?

How is the running rigging of the Practice Ship rove?

Sketch a flying-jib; a jib; a fore topmast staysail; a fore storm staysail; a course; a topsail; a top-gallant sail; a royal; a spanker; a trysail; a lower studding sail; a topmast studding sail and a top-gallant studding sail, and show the gear of each.

What are trysails also called?

ANSWER—Spencers.

Name all the sails of a ship; a barque; a brig; an hermaphrodite brig; a brigantine, and a schooner.

What is a jib topsail? a jib-of-jib? a gaff topsail? a ringtail? a save-all? a spritsail? a spritsail topsail? a driver?

What is the objection to fitting the royal sheets with hooks?

What are called the "light sails?"

Topsails are sometimes reefed from the deck; can you explain how it is done?

HOISTING IN SPARE SPARS AND STOWING BOOMS.

The spare spars are hoisted on with the yard and stay tackles; the yards being secured as in hoisting in boats. Topmasts of large vessels weigh as much as three tons. In hoisting in, if the fore ends take the fore rigging, a pull on the main brace will clear them. Sometimes the yard tackles are crossed.

Spare topsail yards, top-gallant yards, &c., are stowed in *cranes* on each side of the main chains. Topmasts, studding sail booms, &c., amidships. The spare jib-boom is sometimes carried across the stern.

To stow the booms. On the starboard side—the spare main topmast, head forward; the mast fishes; half yard (main) and main topmast studding sail booms. On the port side—the fore topmast, head forward; top-gallant mast; mast fishes; half yard; (fore) studding sail boom and flying jib boom. Most of the small spars are stowed amidships between the boats.

The booms are lashed to span shackles in the deck for the purpose.

The secret of stowing the booms properly is to be able to get any spar required, without breaking out all the others.

QUESTIONS—What are "gallowses?"
What are "cranes?"

THE LEAD LINE.

The *hand-leads* weigh from 7 to 10 pounds; *drift leads* about 25 or 30 pounds; and *deep sea leads* from 50 to 100 pounds.

The line is marked thus: at two fathoms, two strips of leather; at three fathoms, three strips; at five fathoms, a white rag; at seven fathoms, a red rag; at ten fathoms, a piece of leather with a hole in it; at thirteen, fifteen and seventeen, as at three, five and seven; at twenty-two knots.

The deep sea line is marked in the same way up to twenty fathoms; then, one knot at twenty-five fathoms; three at thirty; one at thirty-five; four at forty, &c.

The line is about 100 fathoms long.

QUESTIONS—When is the hand-lead used, and when the deep sea lead?
What is a drift lead?
What is a "patent lead?"
Describe Stellwagen's Lead; also Brooke's Sounding Apparatus.
Show practically how the hand-lead is rove.
How are soundings obtained at sea?
What is the *arming* of a lead?
How is the line bent to the lead?

THE LOG LINE.

The *log-line* is used to determine the rate of sailing; it is wound up on a *reel*. To mark it: allow about ten or fifteen

fathoms for stray line, and put in a white rag; then at every forty-seven feet and six-tenths mark the line as follows, viz: first mark, one knot; second, two knots; third, three knots; and so on, putting a mark also at every half knot.

The principle of determining the rate of sailing by the log-line is that a knot is the same part of a sea mile (6086 7-10 feet,) that half a minute is of an hour; therefore, the length of a knot should be 1-220 of 6086.7, or about 51 feet; but as it is more convenient to have the knot divided into eight parts of six feet each, a proportional reduction is necessary in the glass. Therefore, as 51 feet is to 48 feet, so is 30 seconds to 28.2 seconds; but as the fraction can be more readily allowed in the line than in the glass, another proportion is necessary, viz: as 28.2 seconds is to 28 seconds, so is 48 feet to 47.6 feet, or the length of a knot.

Masters, generally, however, adopt about 46 feet as the length of a knot, as it is safer for a ship to be over-logged rather than under-logged in running for land.

QUESTIONS—How is the log hove?
When is the 14 second glass used?
What is the *log ship*, and how fitted?
Describe Massie's Log.

CHAPTER XIII.

STOWAGE.

The stowage of a ship has reference to stability, speed, easiness of motion, economy of space, and convenience of access, and is therefore a subject of the greatest importance. In the distribution of the disposable weights, the first thing to be considered is the ballast. Its quantity, which is proportionate to the weight of guns, masts, and other top weights, is determined by the builder when designing the ship, whose form and size are so arranged that she will carry the proposed quantity without being too much immersed.

The purpose of ballast is to increase that quality in a ship called *stability*, which enables her as much as possible to resist inclination, and to recover her upright position; and as it seems impossible to accomplish this without the existence of some weight, which will counterbalance the disturbing forces of wind and water and the top hamper of the armament, the supply of ballast is, in the first instance, stowed on the bottom of the ship.

The weight of ballast in modern times is much less than formerly carried.

Ballast is of iron in "pigs," of different weight and dimensions, cast with a hole in each end.

Tanks are selected from the results of measurements made with a skeleton frame, the intervening spaces being filled in with battens, as they are stowed and chintzed. They are slung for hoisting by a toggle in the man-hole; and the lid should be put on, to exclude dirt, as soon as the tank is in place. When the bottom (the ground tier,) is stowed, the others follow.

The ballast is stowed differently in different ships; but the stowage of tanks, casks, provisions, &c., is the same in all. The following from Totten contains all that is necessary to be *read* on the subject. A few days spent in the holds and

spirit room while being stowed will teach the young officer the governing rules:

TO STOW A HOLD AND SPIRIT ROOM.

"The first thing to be attended to is to prepare the hold for the reception of the ballast, by having it thoroughly cleansed and white-washed, and the *limbers* cleared; and then to stow the ballast.

Until within a few years it was customary to nail *dunnage*, that is, strips of board on hoop-poles, athwart the *skin*, on which to stow the ballast. The object of this was to allow a free passage for the water and circulation of the air. This is now discontinued; the ballast is laid on the skin, affording more room, and excluding much dirt.

Pigs of iron are used as ballast by vessels of war, which must be so placed as to promote an easy motion to the vessel. Commence stowing them next to, and on each side of the keelson, on the skin of the vessel, extending forward and aft, from the greatest breadth of the beam towards the bulk-head, an equal quantity and similarly placed on each side; the greatest spread in winging out being athwart the greatest breadth of beam; each succeeding row of pigs placed close to the last; and gradually diminished in length to correspond nearly to the form of the hold.

It being necessary to place a given quantity of ballast near the keelson and about her greatest capacity—which quantity will be according to the model of the vessel—you will be obliged, in a *sharp-bottom*, to place several tiers, one above the other, each one winged out beyond the last in conformity to the dead-rise; while on a *flat floor* the same quantity will be contained in the spread of the first tier.

In winging and lengthening out the ballast, be careful not to form an uneven stowage for the tanks or casks above them—and still place it so compactly that the weight shall bear equally in the body of the hold.

After the ballast, are stowed the *water-tanks* or *casks*. The tanks are made to fit the form of the hold, and are placed, according to their marks, in their proper places. When stowed, they should form on top an even surface, and be placed compactly. They are then wedged with slips of wood, and the

seams caulked and pitched, that no dirt may work down between them.

The tanks are then filled with water, after which the riding tier of casks are stowed above them, placed on beds, and occupy the space between the forward part of the cable-tier and the after part of the fore-hatch; the breakage being forward by the fore-hatch.

Water-casks, not only of the riding-tier, but also those that form the ground-tier in vessels without tanks, should occupy no more space than is absolutely necessary for their proper stowage; a few inches lost might probably prevent the stowage of a tier of provisions. Therefore, to economize in room, the beds should in all cases be made to fit the casks, and only high enough to allow their bilges to be free of the tanks or ballast.

Commence stowing the riding tier amidships at the break of the orlop deck, and stow forward to the after part of the fore hatch, placing two beds under each cask. If the upper surface of the tanks is uneven, the breakages must be filled in with wood. Chime-pieces are also placed between the heads, if the chimes do not match; otherwise they are unnecessary. Stow the next row by the side of this in the same manner, placing hanging beds between the casks, to keep the bilges of each row free. The remaining rows are stowed as before; and when all are stowed, level off with wood, filling up all the breakages under and between the casks. All wood stowed in the hold or spirit room should be previously barked.

Then stow the provisions as compactly as possible, *pork* on one side, and *beef* on the other—and fill in with wood as before.

The space from the forward part of the main hatch, aft to the cable-tiers, is generally sufficient for the stowage of the *dry provisions;* if not, the remainder may be disposed of in the wings over the *wet*.

In the breakage at the fore hold are stored all the *naval stores*, as tar, pitch, varnish, &c.—the *gang-casks*, and all the moveable lumber, such as *spare buoys*, buckets, &c.

Previous to stowing the provisions, battons should be nailed to the beams fore and aft, in which you may stow plank, boards, oars, shooks, &c., placing those which will be most re-

quired in the battons over the orlop. Those in the fore hold are reserved for the small pieces of *iron, spare rammers, sponges, gun-scrapers,* ladles, &c. Under the orlop are stowed spare *gun-carriages, trucks, lower caps,* and other articles that will not probably be required.

The *orlop* is that part of the deck where the cables are stowed, immediately forward, and on each side, of the main-mast. The cables being stowed, there is room enough forward of, and within them, to stow the *stream cable, hawsers, messenger, cat and fish hooks, pendant-tackles, nippers* &c., all of which should be so coiled that one or all of them may be passed up at a moment's notice. At anchor, it is usual to keep one cable-tier always clear, and in the other may be stowed all these spare articles as conveniently as possible.

If the vessel is without tanks, the casks forming the ground-tier should be made to fit the form of the hold, and stowed as directed for the riding-tier, with floor and hanging beds, and chime-pieces. In all cases they should be stowed with their bungs up, and bilges free; commencing aft, and next to the keelson, and stowing forward.

The round shot and chain-cables are stowed in their lockers under the main hatch. The grape and canister shot, generally in the wings abreast of the main hatch.

In the stowage of the spirit-room, the general directions given for the hold will be sufficient to govern you. If any ballast is required there (as is sometimes the case), to preserve the vessel's trim, it is stowed first; then the spirit casks, above which are stowed, as compactly as possible, all other articles, as sugar, tea, tabacco, and slop-clothing, &c."

The sails are stowed in the sale rooms.

The Ordnance Manual contains all necessary directions for stowing powder, shells, &c.

Beef and pork are stowed in the fore hold—beef on one side, and pork on the other.

Beans, rice, flour, butter, &c., in the main hold.

Whiskey, molasses, vinegar, raisins, candles, sugar, tea, coffee, cheese, tobacco, soap, &c., in the spirit room.

Oil and paints in the paint room, which is in the eyes of the vessel.

Boatswain's, gunner's, carpenter's, and sail-maker's stores in the store-room forward, in charge of the yeoman.

Slop clothing and small stores in the Pay-Master's store-room.

Engineer's and Master's stores in the store-rooms appropriated to those officers.

Medicines in the Dispensary.

Wood is stowed in both fore and main holds—and is used in the spirit room to "chock" barrels and boxes.

The sand is put in the sand locker, in the fore hold, and the coal in the bunkers.

Holds should be "broken out" about once in six months, cleansed, and white-washed.

Bread is stowed in the bread rooms, which are lined with tin, and should be washed out with whiskey to destroy vermin.

The store rooms and holds are locked at sunset, and the keys returned to the Executive Officer's room. They are taken out at daylight by the yeoman and master's mate of the hold.

The key of the spirit room is kept in the master's room, and is never taken out but by an officer.

Open lights are never allowed in any of the store rooms or holds.

The Executive Officer controls the expenditures of the master's, boatswain's, gunner's, carpenter's and sail-maker's stores. The yeoman keeps the accounts.

The surgeon, pay-master and engineer regulate and keep their own expenditures.

When an opportunity presents, officers should examine into the stowage, &c., of foreign men-of-war, and note the improvements.

QUESTIONS—Is water generally carried in tanks or casks?

ANSWER—In tanks; most men-of-war carry a small number of *gang casks*, however, to use in the launch and cutters, when watering ship with the boats. In most sea-ports water is sent off from the shore in water tanks, and pumped in.

What is the daily allowance, per man, of provisions and water?

ANSWER—The allowance of provisions is fixed by act of Congress. The daily allowance of water, per man, is one gallon for all purposes.

How does the Master know the position of the tanks, quantity of water stowed, &c. &c., in the ship.

ANSWER—Drafts of the hold and spirit room are furnished him from the Navy Yard.

What causes bilge water?

What remedies it?

ANSWER—Keeping a clean, dry hold. Some officers approve of letting clean water in the ship daily, and then pumping her out dry. Many ships are provided with *air pumps*, which are fitted to the pump brakes, and worked by them for the purpose of exhausting the impure air from below. A free use of windsails is recommended.

How are the holds and spirit room of the School Ship stowed?

How often is a ship's draught taken?

What method is there by which the draught of a ship, forward and aft, can be taken *at sea?*

ANSWER—By the water level. A leaden pipe bent upwards at both ends is let into the lower deck beams under the planking, in a fore and aft line, as nearly amidships as the hatches will permit, the ends are terminated with glass tubes, which are graduated, and for greater security brought up alongside some convenient stanchion. On the tube being filled, the water rises to its level at each end, and the ship's most perfect trim marked off when she is in harbor and perfectly still. Any future alterations in the trim are immediately denoted by the levels.

What is the use of the above?

ANSWER—When carrying a press of sail, a ship buries forward, and unless relieved by moving weights aft, will lose a portion of her speed.

What is the effect on the trim by moving weights in the different classes of vessels?

ANSWER—The following table will convey an idea of the effect which may be produced by moving certain weights through different spaces. It gives the weight which it will be necessary to move a distance of 40 feet, either aft or forward, in order to produce an alteration of *one foot* in the trim of the ship:

Class of vessel and No. of guns.	Length feet.	Breadth feet.	Weight to be moved a distance of 40 feet.
1st rate, 120	206	55	112 tons.
2nd rate, 84	193	52	90 do.
4th rate, 60	174	44	58 do.
5th rate, 46	160	41	38 do.
6th rate, 28	120	34	22 do.
sloop, 18	112	31	14 do.

QUESTION—What amount of ballast is usually carried?

ANSWER—Fixed rules have been given at different times to determine what quantity of ballast should be used, and at present it is much less than it was formerly, as the greater dimensions which are now given to ships have increased their stability, whilst the solidity of the timbers of the frame, chain cables, iron tanks, and other heavy weights, which are now put on board ships, increasing the weight below, and lowering the centre of gravity, have still further added to the stability. The advantages in point of stability which were thus gained have been partially lost by the recent increase in the weight of the armament which is now borne by all men-of-war, an increase which is not wholly balanced by the greater quantity of shot and shell that is stowed below.

The change in the amount of ballast carried formerly and at present may be illustrated by the British ship Caledonia, of 120 guns. In 1814 she had 340 tons of iron and 60 tons of shingle ballast; in 1835 she carried 177 tons of iron ballast, no shingle; and in 1857 the ballast of the same class of ships varied from 100 to 230 tons.

The U. S. frigate Constitution carried but 25 tons of ballast, and some men-of-war carry none.

What is shingle ballast?

What is the meaning of "bung up and bilge free?"

What is the weight of a "pig?"

ANSWER—They are of different sizes—are cast from 7 to a ton, to 40 to a ton.

CHAPTER XIV.

ANCHORS AND CHAINS.

Anchors are formed piecemeal: the *shank*, *arms*, and *palms*, are wrought out of iron bars, hammered together into solid masses, called "Blooms," and then scarphed together. *Stocks* are in length equal to the length of the shank. When of iron, they are 20 per cent. the weight of the anchors, and reeve through a hole in the shank; a curve at one end, and a shoulder and pin in the centre, preventing them from being easily disengaged, but also admitting of their being laid along the shank for convenience in stowage.

Wooden Stocks are of oak, in two pieces, left sufficiently apart in the middle to give greater binding power to the hoops, and to admit of their being driven up when the wood shrinks. In breadth and depth, they are at the middle 1-12th, and at the ends 1-24th of their length.

All the chain gear pertaining to ships, excepting the Rudder chains, is made of wrought iron. The size is denoted by the diameter of the bars of which the links are composed.

Chain cables are 10 lengths of 15 fathoms each; a *swivel* in the middle of every other length, and one *shackle* to each length.

The length of a *link* is 6 diameters of its iron, and its breadth 3.6 diameters of its iron. The end link is rather larger.

Stay-pins, or *Studs*, are of cast iron.

Messenger Chain is made in open oblong links, which are alternately long and short. It is connected by a peculiar *splicing piece*.

Crane chain is made in open, oval links. Having no Stay-pin, its strength, as compared to *stayed* chain, is as 7 to 9; but being more flexible, it is used for rigging, and machinery purposes.

The *Clear Hawse Shackle* is made long enough to clasp a cable link and admit of a hawser being rove through it.

Slip Stoppers and *Devil's Claws* are sometimes used instead.

Top Chains are generally crane, and *Mast-head Slings* of cable pattern.

A first-rate's slip stopper for the cable is about 8 cwt.; a sloop's about 1 cwt. A first-rate's mast-head and yard sling about 32 cwt.; a sloop's about 6 cwt.

The proof strain of chain cables is about 630 lbs. in each circular inch of the iron bolts of which it is made. Thus, a cable made of one inch iron, contains on one side of the link $8 \times 8 = 64$ circular eighths; which, being multiplied by 630 lbs., gives 40,320 lbs., or 18 tons.

Chain cables are meant to be worked with the curves of the shackles *forward*, so as to render readily round the bitts and through the passages on being veered.

They should be marked with the *number* of the shackle on the head of the bolt, cut with a cold-chisel, and also with iron wire round the stay-pin of the link next abaft the first shackle, round the *second* link next abaft the *second* shackle and so on.

The cable ends are secured to chain straps, (necklaces,) which in sailing ships go round the heel of the mainmast.

Chain slips long enough to reach the tops of the *Lockers* are shackled to the necklaces; the slips are stopped up and down the sides of the lockers, and when the ends of the cables are connected to the slips and the tongues of the slips lashed down, the cables are *faked* away in the lockers. The object of this is, that one cable may be connected with another without disturbing the locker; or slipped without endangering a man. Cables are sometimes *lashed* to ring-bolts in the keelson. They should never be *shackled* there; unless with a slip shackle.

TO GET THE CHAIN CABLES ON BOARD.

The cables are put in a lighter with the anchor ends underneath; the lighter being brought under the bows, take the end in through the proper hawse-hole, and with a double whip rouse it in—remembering to pass the end through the *Compressors*.

The *Stream Chain* is gotten on board in the same way and stowed in a separate locker.

The *Messenger* is gotten in also in the same way and stowed below. It is now generally of chain, though not always.

Most works on Seamanship contain Tables, showing the Allowance and Weight of Anchors and Chains.

Before explaining the manner in which the anchors are gotten on board and stowed, the Student should understand the different *Purchases* used; the following is taken from Totten.

"It is an important matter, in hoisting on board any article, to have the yards, on which are your purchases, well secured, that you may not spring the yard, or endanger its rigging.

"The main and fore yards are used for this purpose, in rigging which, there should be straps, with thimbles, placed within the shoulders of the yards, for burtons. To these straps are hooked the single blocks, and to eye-bolts in the lower caps the double blocks of the burtons, (the fall leading on deck.) These are for the purpose of relieving the lifts, and are hauled taut to bear an equal strain with them. In hoisting in any heavy article, as a gun or an anchor, two or more burtons are used, all being hauled equally taut. In hoisting in boats, or articles of less weight than anchors, guns or a launch, it will be sufficient to have the trusses hauled well taut, and to use but one burton in addition to the lift.

"The main yard should be braced *up*, and, if both purchases are used, the fore yard braced *in*, sufficiently to clear the fore rigging, and to render the force of the purchase nearly vertical; and the yards topped upon the side used, before the strain on the lifts and burtons is equalised. The weight of the article purchased is, in a great measure, communicated from the yard to the mast head, while the force of the yard inwards acts upon the fee lift, trussess, and slings, which must be relieved by hauling well taut the opposite lift and the trusses; also hook a rolling tackle to the opposite quarter, and its double block to a selvagee around the mast in the wake of the trusses (fall leading on deck), which must be hauled well taut.

"The following are the different purchases used, viz.: The yard-tackle; winding-pendant and tackle; top-pendant and tackle; quarter-tackle; stay-tackles, and mast head pendant-tackles.

"*The yard-tackle* is composed of a long tackle or fiddle

block, a single block, and the fall. The fiddle block is strapped with a pendant, in the end of which is turned a hook and thimble; the single block is also strapped with a hook and thimble. The pendant to the double block is either short and intended to be hooked to a strap on the yard just within the burton strap; or, as is most approved, is fitted long enough to reach from the lower mast head to the lower yard arms—lizards are fitted on these pendants. The pendant is hooked to the lower cap, and the lizard, (having tails long enough to be secured with two round turns around the yard arms,) when secured, allows the fiddle block to play a few feet below the yard.

"The *top-pendant and tackle* are used in the following manner: Lash a large thimble, or single block, on the yard within the sheave-hole, reeve the pointed end of the top-pendant *up* through this thimble (forward of the yard), then *down* through the top block hooked to the lower cap, or a stout strap around the mast head; then on deck. Having hooked to the thimble in the lower end of the pendant the upper block of the tackle, haul down the lower end until the double block is the requisite height, when the end of the pendant must be well secured on deck.

"The *winding pendant and tackle* answers the same purpose as the top-pendant and tackle, but is differently rigged—thus: The pendant to which the double block is strapped, is of sufficient length to reach from the burton strap on the yard arm to the lower cap, to which it is hooked. On this pendant another short pendant traverses with a thimble, in the other end of which is turned a hook, which hooks to a stout strap around the yard just within the burton thimble. Thus, when used, the double block of the purchase hangs below the yard.

"When both the top and winding purchases are used, the pendant of the former may be secured around the top-mast head, sitting well up the opposite back-stays. These purchases, varying so little in their construction, should be each of sufficient strength to hoist in or out the launch, so that but one purchase on the yard may be used. They and the quarter-tackle, are used to raise the articles, while the stay-tackles serve to guy them inboard, and lower them to their respective places.

"The *quarter-tackle* is a tackle of less power than the yard, winding, or top-tackle—is used on the fore or main yards (generally the latter), to hoist in or out water casks, or lighter articles. It is a long tackle purchase, with a pendant to the double block, which is hooked generally to the strap, for the purpose on the yard, or to a selvagee around the yard; used further in, on the quarter of the yard, than the yard-tackle, hence the name.

"The *triatic-stay* consists of three parts, two pendants and span. The pendants, with hooks in their upper ends, which to bolts in the lower caps (fore and main), or are secured around the mast head. In the lower ends of these pendants are turned thimbles, into which the stay-tackles hook. These pendants are spanned together by another rope, the ends of which span are turned around thimbles which traverse on the pendants. The length of the span will be the distance you wish to have your pendants apart.

"Vessels stowing two tiers of boats, should always be supplied with two triatic-stays, so as to hoist in the boats on their respective sides.

"*Mast head pendant-tackles* are used to hoist any heavy articles out of the fore or main hold; to transport or fish anchors; or in any case where the purchase is required immediately over the deck. They are also used in place of stay-tackles to get the boats in when the vessel is not supplied with a triatic-stay. They do not answer as well for the latter purpose, as they act too obliquely, and are seldom thus used.

"In hoisting in lighter articles, as water casks, with the main yard, a quarter tackle and a single whip only on the main stay are used. The fall of the yard tackle leads through a snatch block hooked to an eye-bolt, in the deck by the main-mast on the same side; and the fall of the whip leads over the opposite side of the deck. While hoisting on the yard tackle, a few hands take in the slack of the whip. When the cask is sufficiently high to clear the hammocks, a turn is taken with the whip, and the fall of the yard-tackle is eased over a pin or cleat abaft, until the cask is over the hatch or gangway, when the tackle and whip are lowered together, and the cask landed."

TO GET ON BOARD AND STOW A HEMP CABLE.

Hemp cables are going out of use, though most ships carry at least one. The allowance being: two chain bowers, one chain sheet, and one hemp sheet.

To handle a large hemp cable properly—keeping it clear of kinks—requires a good knowledge of rope.

The following is taken from Totten:

In receiving a hemp cable in the lighter which is to convey it alongside of the vessel, you should coil it with the sun, by which each fake takes a turn in the cable, and in receiving it on board from the lighter, it should be french-faked, fore and the decks, by which the turn is taken out, and the cable then has its original lay.

In coiling a cable in the tier or on the deck, every oblong or circular figure formed, is termed a *fake;* and when several of these are formed one within the other, the whole is termed a *sheave.*

Shot is a term used when there are two or more cables spliced together; thus the bower or sheet cable may consist of two or more shots. When of but two, the inner end of the lower one and the outer end of the upper are crowned or capped, and the other ends tailed and spliced together. When there are three shots, the ends of the centre one are tailed and spliced together. When there are three shots, the ends of the centre one are tailed and spliced to the tailed ends of the upper and lower.

The lower ends of cables are secured around the orlop deck beams, or around the mainmast.

Hemp cables are coiled in the tiers with the sun, crossing in the hatchway, that is, the starboard one is coiled to the larboard, and the larboard one in the starboard.

Avoid having too many fakes in a sheave, for when there are, the cable composing the inner fake is injured in bunking in.

After forming the lower sheave, the cable is taken out to the sides of the tier, and another sheave formed over the first, and so on; leaving room in the centre of the tier in which may be coiled hawsers, or where may be stowed nippers, deck-stoppers, &c.

Crown-ropes are used in the corners of the tiers to keep the fakes in their places.

To *french-fake* a cable or hawser along the deck; the bends are made to lap one over the other, and the different layers between the bends form parallel lines on the deck. This is the proper manner of coiling a cable or hawser for running; the bending end forms the first fake, and is taken out towards the ship's side, and each succeeding fake approaches nearer to a straight line between the hatch and bitts, each bend underlapping the former one. Thus the running part of the cable or hawser will always form the upper fake.

To crown a cable: Pass a seizing around it about one fathom from its end and unlay the seizing; lay up the three inside or heart strands, and make an over-handed wall knot around them with three of the other strands, working them over the three remaining ones. After having them well taut, worm them in the lay of the cable, and pass three seizings around them; whip the ends of the other strands and cut them off. Sometimes a flemish eye is worked with the inner strands, which must be done before the wall is formed.

Capping a hemp cable is thought by some officers preferable to crowning.

To sail the ends of a cable. A whipping must be put around each strand, about twice its circumference from the end; unlay them and connect with the heart yarns, the tails which should be four fathoms in length. Sennet is made of the outside yarns for pointing. The ends are then tapered, mailed and pointed; the length of the pointing must not exceed once and a half the circumference of the strand.

Splicing. Cables are connected by a short-splice thus; the ends of one are passed through the strands of the other twice, and the ends of the other only once. The ends of the best cable should be passed twice. After splicing, worm the tails in the lay of the cable, and put on the seizings, thus, one around the middle of the splice, and two around the ends or at the termination of the splice, and three or four around the tails.

MESSENGER, NIPPERS, STOPPERS, &C.

Messengers are of chain and hemp. If of chain it is run

round the capstan and manger rollers, the turns taken out, the after bight placed on the *sprockets*, and the rollers being at their aftermast positions, the ends are adjusted as to length, and connected with a peculiar splicing shackle.

The manger rollers are movable, so that they may be adapted to the gradual stretch of the messenger.

Patent iron nippers are used in this case.

If a *hemp messenger* is used it is a cable-laid rope of the same size as the stream cable, or five-eights of the working cable; in length it should be twice the distance from the capstan to the hawse-hole, plus four times the circumference of the barrel, having in each end an eye for lashing together.

To pass the messenger If it is your intention to bring to on the larboard cable first, the end of the messenger is passed up on the larboard side of the deck, taken aft and passed around the capstan with three turns, and the end taken forward as far as the main hatch; that part of the messenger which brings in the cable, or rather that upon which the capstan directly acts, forming the lower turn around the capstan. The other end of the messenger is, in the mean time, taken forward on the larboard side of the deck, passed around the roller under the bowsprit, and taken aft on the starboard side to the main hatch, where the two ends are lashed together, thus.

In one of the eyes is spliced the lashing, which is passed alternately through each eye in a figure of eight form, each part crossing the one adjoining it; the eyes being kept one and a half fathoms apart; the end of the lashing is secured by seizings; the slack of the messenger is then hauled around on the starboard side of the deck, bringing that on the larboard side taut between the capstan and roller.

To dip the messenger. After heaving in one cable it becomes necessary to reverse the turns around the capstan, that the lower one may be convenient for heaving in the other cable. It is only necessary to unlash the eyes, slack the turns around the capstan. and pass the lower end up, or the upper end down (whichever may be most convenient) through the turns. After which, haul taut the turns around the capstan, and lash the eyes as before.

Nippers by which the messenger is secured to the cable are formed of yarns marled together like selvagees, or of fox-

es laid up after the manner of a coach-whip; the former are of more general use, they are about four fathoms in length.

In passing the nippers. If in light weather and only to heave in the slack of the cable, or heave short; a round turn is taken on the messenger with the after end, and the remainder of the nipper is expended around the cable and messenger against the saw; having enough to twist up with the end of the next nearest nipper.

When short a peak, or when blowing fresh, two round turns are taken with the after end around the messenger, and two with the forward, and around the cable, twisting the ends up with the adjoining nippers as before, and in heavy heaving, racking or jambing turns may be taken.

Hanging nippers are much used in heavy heaving, and are found very useful, owing to the facility with which they are applied or removed. They are selvagees of sufficient length to enclose the cable and messenger, and admit heavers to be thrust through their bights; which heavers are hove around until the nippers are taut; they may be also applied over the common long nipper, when the cables comes in covered with mud, to prevent the nippers from slipping.

Stoppers, used for securing the cable, when at anchor, are the *deck*, *dog*, *ring*, *bitt*, and *hatch* stoppers.

Deck stoppers are made of hawser-laid rope, are one fathom in length, when fitted, and are, in size, one-half that of the cable on which they are applied; in one end is spliced a hook and thimble, which is hooked to the stopper ring-bolts on the deck; in the other end is formed a double wall and crown knot, with a lanyard, one-third the size of the stopper, close to the knot; the knotted end of the stopper attached with a running eye around the stopper close to the knot; the knotted end of the stopper is passed with the lay of the cable, and the lanyard is passed against the sun around the cable and stopper with several turns, leaving a fathom of the end to worm forward in the lay of the cable, the end is then secured with a seizing.

Dog-stoppers are four-fifths the size of the cable on which they are used, and are from four to five fathoms in length; they are unlaid nearly their whole length from the ends, and are gradually tailed and marled after the manner of selvagees; or the yarns are laid up in foxes, and the tails formed of square sennet or coach-whipped.

They assume different names, according to the purposes for which they are used; such as *bitt, wing*, or *hatch* stoppers; they are termed *bitt stoppers* when used at the bitts, *wing stoppers* when secured to the knees in the wings of large vessels, in readiness to apply to the cable when veering in heavy weather; and they are termed *hatch stoppers* when used at the hatches for the same purpose.

Ring stoppers are unlaid from the ends towards the centre, and worked up nipper fashion; enough being left laid up in the centre to clove-hitch to the ring-bolts in the deck, being thus secured, one end is passed on each side of the cable, one worked into its lay, and the other passed across the first. Their length will depend upon the size of the cable.

To stopper a cable. For a hemp cable, deck stoppers and dog bitt stoppers are used. Place the stopper in the lay of the cable, and pass the lanyard around the cable and stopper against the sun, having a fathom of the end to worm forward in the lay of the cable. Forward of the bitts is another stopper passed in the same manner. And a bitt stopper (used principally in heavy weather) is passed thus: Put the bight over the tier part of the cable, abaft bitts, take the ends under the cross-piece and dog them forward of the bitts around the cable. Or it may be used thus: having passed it through the hole between the standard and bitts, the two ends are passed around with dogging turns, and the ends seized to the cable.

Ring stoppers are also very useful and neat. The bights are passed over the cable abaft the ring bolt, both ends are rove through the ring, and dogged around the cable forward of the bolts; the ends are tapered, coach-whipped, and laid up in square sennet.

TO GET ON BOARD AND STOW THE ANCHORS.

Having rove the Cat and Fish falls, tow the lighter containing the *Bower Anchors* under the bows and shackle the chains; overhaul down the *Cat* and *Fish;* hook the Cat to the ring of the Anchor and the Fish to the inner flue, and walk away with both together—when up, pass the *Cat Stopper* and *Shank Painter.*

If the Anchor can be lifted by the Cat alone, without endangering the lighter, the Fish need not be used.

In all cases of handling Anchors before the chains are bent, a hawser large enough to weigh it should first be bent to the ring, and kept clear for running.

Tow the lighter containing the *Waist* or *Sheet Anchors* alongside, and moor her so that the anchor will be under its berth. Brace the fore yard *in*, and the main yard *up* as much as possible, top them up a little; hook the burtons and rolling tackles, and haul taut lifts, trusses, burtons and rolling tackles. Send up the winding-tackles, putting the bull's-eyes, through which the pendants reeve, just far enough out to allow the Anchor to be lifted clear of the ship's side. Send up, also, the Triatic Stay and Tackles. Have a Thwartship tackle in readiness to house the anchor to its berth. Lash the lower blocks of the main purchases to the crown of the anchor, (having guys from the flukes to steady it,) and the fore purchases to the ring. Rack the fore topsail tye aloft, and hook the lower block of the fore topsail halliards to a strap around the shank of the Anchor, lashed up along the stock. Sway away, and when high enough, haul over on the Stay and thwartship tackles and get the bill of the Anchor upon the gunwale. A cleat is nailed on the lower part of the stock, a lashing passed under it and round the timberhead in the after part of the fore-castle bulwark for the purpose; another lashing from the same place to the upper part of the stock, and frap all together. A *slip shore* is fitted from the side on which the Anchor rests, and the lower end of the Stock sets in the *Trip Stopper*. A lashing is passed round the shank through a span-shackle bolt in the side; the inside fluke rests on a *bill-board* on the fore end of the chess-tree, or after part of the fore chains. The Anchor being secured, send down the purchases, drop the lighter round on the other side, and take in the other anchor in the same manner.

English Men-of-War are provided with a moveable Fish Davit, with which to get on board and stow the Waist or Sheet Anchors. The following is the method as described by Boyd:

"Rig the Davit-head with fore and aft *guys*, a three-fold block for the *purchase*, and a runner block for the *topping*

lift. If there be no good place for a *step*, form one with cleats. Reeve the runner, place the davit, lashing the heel lackly, so as to allow for topping; make the runner and tackle fast on the opposite side of the deck, reeving its fall through a lead, and belaying abaft. Reeve the purchase with a piece of rope as large as the Cat fall, using another three-fold block. Make the standing part fast to the davit head, and lead the hauling one across the deck through a lead aft. Steady up the guys and lash the lower purchase block on the upper side of the shank, about half way from the crown; the crown, of course, being aft. If the lower yards are up, their tackles are useful on each end of the anchor to steady it and keep it square; if not, any tackle outside the fore rigging, on the upper stock, will do. If, on weighing, the anchor is not well poised, it must be lowered and relashed. When it is up high enough, the fall is belayed, the davit topped by the runner, the stock and shank painters are passed and bowsed to, the *tumblers* are raised and placed under the shank, and the anchor lowered on them and secured, keeping the edge of the fluc well on the bill-board The upper arm is confined by a *slip lashing*, and a *tripping Strop* is passed round the lower one.

If the *Ganger* is in the lighter, it will save trouble to bend it before hauling ahead."

The *Stream Anchor* is gotten in with the Yard and Stay tackles, and is conveniently stowed when placed flat on the decks, amidships, at the bows of the boom boats. It is usually carried out by the launch, and when the tackles have hoisted the boat out, they are available for doing the same for the anchor.

The *Spare Anchor* (Bower) is gotten in with the winding and pendant tackles, and is stowed in the main hatch, below. the Berth deck, with the crown up, and securely lashed.

The *Kedges* are stowed in different places—the largest in the Fore Hatch; two on deck under the bows of the boom boats, and others in the chains.

Grapnels—both *Hand* and *Boat*—are stowed in the Fore Hold.

All spare gear belonging to the Anchors and Chains—such as mooring-swivels, shackles, nippers, chain hooks, hook-ropes, &c., is generally stowed in the Fore Hold.

TRANSPORTING WAIST ANCHORS.

The Waist or Sheet Anchor is "let go" from its berth. Upon heaving it up, it is first Catted and fished, and must then be transported aft to its place by means of the Fore and Main Yards. To do this: Secure the yards as for "Stowing a Waist Anchor;" the main yard is braced forward, the fore yard aft, and both secured. Put a preventer brace on the fore yard from the bowsprit cap, and a burton on its quarter, to assist in "lightening up" the chain as the anchor goes aft. Cat the anchor on the right slew, with the upper stock aft; hook the main winding tackle and the yard tackle to a strap on the crown and mouse the hooks; hook the fore winding tackle to the ring, and the fore yard tackle to a strap made fast to the ring and lashed half-way up the upper stock; pass a hawser over the cat-head stopper-cleat, through the anchor ring, and make its end fast round the cat-head. Hook the yard burton under the cat-head, inside the hawser to the cable, about three fathoms from the ring; ease the anchor down by the hawser; let it hang with the ring awash and unhook the cat. [The hawser is used to avoid having to overhaul the cat fall as the anchor goes aft.] Haul taut all the gear, easing away the hawser, and paying out cable, bearing in mind that the more the anchor is slacked away under the yards, the more equally will the winding tackles operate. Keep the bight of the chain up with the burton, and the upper stock with the fore tackle. If the "drift" is long, put another tackle from the cat-head on the cable, so as to relieve the burton, and let the anchor go aft freely; when up, the main tackle—or if not, the fore stay—will bring the fluke in on the bill-board.

The anchor can be transported without lowering it in the water, by bracing the fore yard forward, lifting the anchor with its purchases, and then bracing the fore yard aft—using the main purchases as before; but as a general rule, avoid *bracing a yard after having lifted a heavy weight*, as the risk of "springing it" is great.

English ships use two davits for performing the above operation when lower yards are down, or when otherwise it is not convenient or desirable to use them. It is performed thus:

Rig both davits, one a little before the place where the stock stows, and the other at where the fluke stows. Use the cat fall and block (taken from the opposite side) for the foremost one, and the usual fish gear for the after one. When the anchor is up to the hawse hole, hook, haul taut, and belay the cat-head cat, and stick out cable; hook the after cat to the anchor ring, and the fore yard burton to the cable as before; pay out chain; lower the anchor well down, so as to overhaul plenty of the forward cat and then walk the anchor right up to the foremost davit and fish it with the other one.

After all, little can be learned by young officers by *reading anything* about transporting anchors. When an operation of the kind is performed on board ship, the executive officer should *command* the presence of all the Midshipmen. This old rule is, unfortunately going out of fashion, and the effect is but too evident.

To transport a Waist Anchor to the bows; the best way is to *let it go*, and then heave it up, cat and fish it. This operation is not often required to be done.

Waist Anchors have sometimes to be transported from one side to the other. In port, the proper way to do so is to let the anchor go, heave it up to the opposite bow, and transport it aft as above explained. At sea it can be done by hanging it with the fore yard purchases, bracing the yard forward, and with tackles on the fore stay and slings of fore yard transferring it to the other yard arm: or it can be taken across abaft the foremast by using the fore and main pendant tackles. It is an operation requiring much care, and one which it is useless to describe. It should be avoided if possible.

Young officers can only learn the use of purchases by *constant observation*. No *book learning* will enable them to purchase and transport Anchors, Guns, &c.

TO BEND A CHAIN CABLE.

Put a single block on the stock of the anchor, reeve a *ring-rope* through it, take the end of the ring-rope in through the proper hawse-hole and bend it to the chain, with a rolling hitch, a few feet from the end; put a good stop on the end, and rouse out on the ring-rope. When up to the ring of the Anchor the Armorer shackles the *Jew's harp* to the ring.

TO BEND A HEMP CABLE.

Reeve the ring-rope, if for the starboard cable, through the ring of the anchor from *in, out;* pass the end in the hawse-hole and bend it to the cable with a rolling hitch some distance in, and stop it along towards the end. Rouse the cable out through the ring of the anchor, and when end enough for clinching, stop it to the ring. Make an inside clinch *with* the sun, with the end round the other part. Put two *bends* on each clinch, one around the end of each and its adjoining part, and the other opposite to the end ones around both parts.

In bending a sheet cable a ring rope should be rove, also, through a leading block on the cat-head, and bent to the cable at a distance from the end equal to the distance from the hawse-hole to the main hatch, and stopped along towards the end. This is to assist the other ring-rope; the stops being cut as they approach the cat-head.

Hemp cables are but little used, not more than one being now supplied, and the outer part of that is of chain—called a *Ganger*. The Ganger is shackled to the ring of the Anchor, hauled in the hawse-holes and then connected with the hemp, either by shackling or splicing. It is stopped up outside, and generally kept bent.

Boyd says, "Hemp cables are usually made with a shackle spliced into one end, and it is well to fit the other in a similar manner."

"When supplied with splicing tails, the end is unlaid for some distance; and, after leaving end enough for the tails, laid up again. It is now open enough in the strands to admit of being fidded out for splicing. Put a seizing on at the place from which it is unlaid, open the strands of the tails, taper and plait them down, finishing with a piece of rope. The chain tails are puddened and hitched down; then proceed with the chain and rope tails as with a common splice, expending the ends along the lay of the cables and seizing them down."

"Coil hemp cables, both in the lighter and tier, right handed, clinching the lower end in the heart of the tier to a chain strap round a beam, and lashing down to an adjoining one."

Hemp Cables are marked with marline at every five fathoms from the clinch.

TO RANGE CABLES.

Hemp cables are roused up from below with whips and *French faked* fore and aft the deck; running part outside.

Chain cables should be permitted *to run from the lockers*—sometimes, however, it is found that owing to the lockers being small and chain badly stowed, or to the swivels not turning, the chain *kinks* below, and is likely to jamb in the chain-pipe. In that case a range may be gotten up, abaft the bitts, running part outside

Hemp cables require a range forward of the bitts; Chain cables never; and only one abaft, in the case just cited.

The Compressors will always control them when running.

BITTING CABLES.

The starboard cable is bitted with, the front cable *against* the sun. A hook-rope is rove through a block hooked to a bolt in the beam over the bitt-head, and hooked to the cable a little abaft the cross-piece. Light forward the chain, trice up the bight and throw it over the bitt-head; the after part being on *top* and *outside;* the forward end *underneath* and *inside.*

The *buoys and buoy-ropes* are now put on the anchors, and the chains hauled taut in. No buoys are used for the sheet anchors, nor are buoys used at all by steam propellers, for fear of fouling the propeller. The object of the buoy is to indicate the position of the anchor when on the bottom; and the buoy-rope is supposed to be strong enough to weigh the anchor. Care is taken that the buoy-rope is not longer than is necessary to let the buoy *watch* at high tide.

FISH DAVITS.

Various kinds of *fish davits* are in use. In sloops-of-war a horizontal davit is used. The fish pendant fits in a score in

the outer end, and the pendant tackle is hooked to a thimble in the upper end. It is rigged out by a *heel tackle*, and kept down by a *jumper*. In fishing the anchor, as the fish hook comes up to the score, the jumper is slacked, which allows the davit to rise, and then, by easing the heel tackle, the fluke is brought in on the bill-board.

The ordinary fish davit is stepped in a *shoe* in the fore chains. The fore pendant tackle is hooked to the middle eye-bolt in the head of the davit as a *topping lift;* a large double and double strapped block, and another single and single strapped, both having eyes large enough to go over, are placed on the davit end. The eyes of the fore and aft *guys* are then put over, and the ends set up taut with a laniard—one at the cat-head, the other in the after part of the chains.

The *fish block* is double, double strapped into a large hook, and hooked by means of a *back* rope. The fish fall is rove from inboard through the single block on the davit end and full through the others, the standing part being made fast to the fish block.

Sometimes the hauling part of the fish fall is carried to the mast-head, a luff is placed from a bolt underneath on the bends to the davit end as a *martingale*, and when the latter tackle is eased, the fall answers the purpose of a topping lift. This davit is shipped, or stepped, by means of a luff tackle on the foremost swifter, and when not in use, is stowed below in the fore hold with all the cat and fish gear.

Still another kind of davit is used in large steam frigates, where the foremast is stepped so far aft as to render the one just described impracticable. A long spar is shipped with a goose neck to a bolt on the forward side of the foremast; when not in use for the anchor, it is *crutched* between the knight-heads, and the awning is spread over it. The fish pendant is rove through a single block, and the pendant tackle hooks to a thimble in the upper end. A stout pendant goes with an eye over the davit end, reeves through a block *strapped to the single block through which the fish pendant reeves*, then through a sheave near the davit end, and through a block at the foremast head. When the anchor is high enough by the pendant tackle, by easing away the pendant described, it is brought in on the bill-board. This davit has

a topping lift and guys on either side, and is very handy for many purposes where a *derrick* is required.

CAT FALL AND BLOCK.

The *cat block* is iron-bound, three-fold, with a standing large block; the *fall* is rove from inboard through the *foremost* sheave in the cat head, the *foremost* in the block, and so on full; the standing part being made fast to the cat-head with a timber hitch. The fall is first rove through the foremost sheaves, that the other parts may not *ride* whilst hauling them through, when the tackle is lead forward to hook. A *cat back* is bent to the back of the hook of the cat-block, to assist in hooking it.

When the anchor is catted, the cat stopper is passed, and the cat-block *unhooked* before fishing the anchor, for fear of splitting the block.

CAT STOPPER AND SHANK PAINTER.

A piece of rope, stout enough for the purpose, has a stopper knot in one end, is rove down through a hole in the cat-head, and hauled taut. It is wormed, parcelled, and served in the wake of the cat-head, and sufficiently far towards the end to take the ring of the anchor. The end should have a becket put in and be pointed over. Bend a small rope to the becket for convenience in reeving. *To pass the stopper:* take it through the ring of the anchor, over a cheek on the fore-side of the cat-head, in through a hole in the bulwarks; put a jigger on it, haul taut, and belay to a *kevel* or *timber-head.*

The *shank painter:* a piece of chain is secured to the side; a large thimble, well parcelled, is put into the last link; round this thimble splice the piece of rope intended to make the tail of the painter. The other end is pointed, with a becket in.

To pass it: Take the end round the shank, close to the crown, haul taut and belay to the timber-head.

The cat stoppers and shank painters should be passed so that, when let go, their ends will be thrown *downwards.*

Patent trick-stoppers are now generally in use for letting go the cat-stopper and shank painter together.

Cat-head stoppers and buoy-ropes are one-third the *size* of the cables.

HOISTING IN GUNS.

The Ordnance Manual contains instructions for getting the guns in. The following from Boyd is, however, very instructive on this point:

"For taking in or hoisting out 'between deck' guns, no purchase that can be rigged is so quick, safe and convenient as the *davit*, excepting the cat.

But the cat-head is only available when it overlooks a port; the davit may be rigged anywhere, as is evident in the case of the waist anchors.

Whichever of these two methods be adopted, it must be observed that the longer the slings are, the less will be the lower purchase block nip against the upper port sill. If the cat block be used, the hook should stand outwards, and whatever kind of purchase be used in working guns through ports, the port should be lined, and the port lid and sweep piece unshipped.

For 'tween-deck guns, a hole is cut through the plank of the deck overhead in a line with the centre of the port, and something more than the length of the gun-carriage from the side; through this the eye of the strop of a clump block is rove, which is toggled on the deck above, and wedged nearly close up.

The runner of a tackle is rove through a block on the other side of the deck looking straight into the clump, led through the clump and *clinched* into a good hook: this is the garnet. Its duty is, when hoisting in guns, to hook on to the neck ring of the gun, and when the button is as high as the lower port sill, to haul the breach inboard up to the beam of the deck overhead, whilst the carriage is placed under it.

The gun is slung on its upper side by a pair of rope slings; one bight of which goes over the neck, both parts being seized together, leaving an eye large enough to be easily thus placed; the other end is hauled taut along the gun, and a lashing is passed round slings and gun outside the trunnions; to this end the purchase hooks. The gun is hoisted muzzle

upwards; the gurnet pulled up, the purchase let go, and if *nicely* lashed at the right spot, the trunnions fall right into the boxes; the cap squares are turned over, the forelocks put in and twisted.

TO RIG A YARD PURCHASE—SAY STARBOARD SIDE.

Brace the main yard so as to overlook a convenient port; line that port; unship the port lid and strap piece, and then measure for the gurnet hole. Top the yard, hook the port yard tackle, or a rolling tackle, to a strop on the mast at the necklace, reeving the fall there, and sending it on deck. Put a long tackle on the starboard yard-arm from the cup, hooking it to a strop on the yard far enough out to plomb a lighter's hatchway. In small ships put a cross lashing on the bunt of the yard round the mast; haul taut all the gear, and have the heel of the boom well secured. It is not singular to shake the lee one off whilst hoisting in. Reeve a set of top tackle gear on the deck, running the top block down the pendant close to the upper top tackle block, and rack it there. If the yard is forward, and the starboard main-topsail buntline down abaft the main yard, and a double whip from the main lift put on in a line with the strops of the preventer lift.

Trice the top block up with the whip, and the pendant with the buntline. Secure the pendant over the main cap, putting some mats between them. Lash the top-block round the main yard alongside the strop of the preventer lift, and cut the racking.

Put a whip on the lower block from the off side of the lighter, to round the purchase down with, and work its fall on the deck of the ship. Lash a long tackle on the foremost pendant starboard side for the gurnet. If the top tackle fall is short, let down the pendant, and if the yard is small and the weight to be raised great, tail the fall and carry it through a leading block at the upper top block to the mast-head, and thence to the deck.

Another way to rig the gun purchase is to arrange every thing as before described, but omitting to lash the top block, and putting a runner and tackle on the yard for an outhauler; then lash the runner block at the yard-arm, pass the runner over the main cap, rounding the tackle close up, and secur-

ing the runner round the mast-head; make the lower block of the tackle fast to the top-block; haul out on the tackle until the purchase plombs the hold of the lighter; when the gun is up, ease in the tackle, and so on.

In hoisting guns out with this purchase, the purchase is eased in far enough to plomb the port; and when the gun is weighed, the runner tackle is hauled out far enough to admit of lowering it into the vessel alongside.

In most cases where this kind of purchase is made use of, there is more strain on the runner tackle than is quite safe; especially when the lighter is not an open one, and the purchase has to plomb the hatchway.

Heavy main deck guns, such as a frigate's, are far more easily and safely handled through the ports than the skids. In the latter way, the lifting purchase seldom, if ever, plombs the carriage; the gun binds, jiggers and hand spikes are required; and with a double strain on the gear, it is dragged on or off the carriage both in coming in and going out, to say nothing of the additional 10 feet hoist. Top tackle gear *may* stand this, but a launch's purchase is not equal to it. It lightens work very much if the axles and insides of trucks are cleaned and greased before taking the guns in.

If there be delay about carriages, and time presses, lower the guns on the deck, putting trucks on the trunnions as they are being lowered.

In throwing guns overboard on shore, buoy them with the trucks and breechings.

A brig which was too small to admit of a derrick, being rigged, was thus quickly and efficiently fitted in raising the guns of the "Formidable." A span was formed with two parts of the chain cable, close hitched round each mast head, the after ends set up at the stern, and the foremost ones over the bows through the hause holes. A top-gallant yard from the ship being lashed fore-and-aft at the mast-heads, assisted to prevent them from being drawn together. The purchase was lashed on the span, and worked over the side."

QUESTIONS—Name the parts of an anchor.

ANSWER—An anchor is composed of four parts: the *ring*, the *shank*, the *arms*, and the *stock*. The ring, to which the cable is attached, is fixed on one extremity of the shank, and

the arms on the other extremity. These arms consist of the *palms* or *flukes*, and the *bill;* the palms are the broad plates of a triangular form, at nearly the extremity of the arm; and the bills are the sharp points at the very extremity. The *throat* of the arms is the round angular point where the arm is joined to the shank. A distance equal to that between the throat of one arm and its bill, is marked on the shank from the place where it joins the arms, and is called the *trend.* The *crown* is the place where the arms are joined to the shank. The *small round* is the diameter of the shank where it is smallest, which is near the square part where the stock is fixed. The *stock* is a beam of wood, or an iron bar fixed at right angles to the plane passing through the arms.

Rings are dispensed with since the introduction of chain cables, and larger *shackles* substituted; the *stock* is now made in one piece instead of two, as had to be the case when rings were used.

QUESTIONS—Sketch an anchor and point out the parts.

Describe Porter's anchor; Rodger's anchor.

What is a jury anchor?

Describe Mitchel's *screw* for mooring purposes.

What resource have we for "bringing a ship up," having let go all anchors?

What are the *stay pins* of a chain and their use?

Why are chain cables preferred to hemp?

Describe a *slip stopper;* a Devil's claw.

How are the *bolts* of shackles kept in place?

What is a *swivel*, and its use?

What is a *mooring swivel*, and its use?

What is a *splicing shackle?*

What is a *compressor*, and its use?

ANSWER—The *compressor* for chain cables is an iron elbow, one end of which is bolted to the forward beam of the hatch underneath, and intended to work on the bolt. The elbow goes round the cable, having an eye in the other end, to which a luff tackle is hooked; which being hauled on stoppers the cable effectually.

Describe *Mix's patent stopper.*

What other patent stoppers are in use?

Are *messengers* always used?

Explain the manner of fitting a capstan for use without a messenger.

What is a *jig back?*

What patent iron *nippers* are in use?

What is "surging" the messenger?

What are *chain hooks*, and their use?

How are *hook ropes* fitted, and their use?

What is a "cable's length?"

What anchors and cables are allowed a frigate?

What is the weight of bower anchors for the different classes of vessels?

What is "double bitting" and "weather bitting?"

ANSWER—Double bitting is bitting round both the forward and after bitts: weather bitting is taking another turn over the bitt-head.

Describe the round, iron-cased bitts.

What is the use of the *stock* of an anchor?

Why are iron stocks preferred?

What is meant by a buoy "watching?"

What is "bleeding" a buoy?

Explain the various methods of fitting *buoy ropes.*

Where are hawsers stowed?

What is a *hawse buckler?* a blind *buckler?* a *jackass?*

How is a bower anchor secured when hove up?

What is a *trip stopper*, and its use?

What is a *slip shore*, or *tumbler*, and its use?

How is a bower anchor let go?

How is a sheet anchor let go?

If the sheet anchor is stowed so far in that the trip stopper and slip shores will not throw it clear, how is it done?

ANSWER—By putting a strap on the bill, hooking the main yard-tackle to it, and throwing it off.

In stowing sheet hemp cables below, why are they *crossed* in the main hatchway?

In handling anchors before the chains are bent, why should a hawser be bent?

What is a *bill-board?*

What is the *stream* anchor used for?

Why are the large steam frigates provided with two cat heads?

ANSWER—Ths anchor is catted from the bows with the

forward one; and before going to sea is shifted to the after one—by simply hooking its cat, slacking down the first, and walking away—for the purpose of bringing the weight further aft.

Describe the patent "trick-stopper" used for letting go an anchor.

If a nipper jambs, how do you clear it?

Describe the method of heaving up an anchor, catting and fishing, and securing it for sea.

ANSWER—The capstan is "rigged;" that is, the bars are shipped and "swiftered in," by the carpenter and his mates. The bars are swiftered so that they will not fly out in case the capstan should "get away" from the men and fly round rapidly.

The messenger is gotten up and passed under the direction of the gunner; the pawls of the capstan arranged; and the quarter gunners are stationed at the barrel of the capstan, with heavers, to keep the turns of the messenger (if hemp,) from riding. The "jig-back" is hooked, and men stationed at it, and also to "light round" the messenger. The fore and main topmen get up the nippers, hook-ropes, chain hooks, sand, &c., under the direction of the Master, who is responsible that *everything* is in place.

The boatswain has already had the cat fall rove and overhauled down, and the fish davit and fall prepared.

The chain is "brought to" the messenger with the nippers, and the messenger "hove taut." If there is any slack chain on deck, the chain is now unbitted; otherwise, that must be done as it comes in, by dipping the bitt-rope under, and bending to the chain (following the lead,) about a fathom forward of the bitts.

The stoppers are taken off as soon as the messenger is hove taut, and the cable and messenger lifted up on the cross-piece for convenience in putting on nippers.

The commands in succession would be: *bring to—heave taut—off stoppers—unbit—heave round.*

As the chain comes in, the nippers are passed, from aft forward; the ends are "married" together, and a hand seizes and walks aft with them, and takes the nipper off when abaft the after bitts. Sand is used when necessary. If iron nippers are used, they are put on at equal distances, and the after-

most one knocked off just *after* the foremost one is put on; arranging that *two* may always be on.

When the anchor is up, the cat is hooked and the fall manned. The Master having kept slack chain enough on deck to allow for catting and bitting, the forward nippers are taken off, and when the cat is hauled on and the boatswain pipes to "beer," the messenger is "surged" and nippers taken off.

The anchor is then catted, the stopper passed, the cat block unhooked, and the anchor fished by hooking the fish hook to the arm, and walking away with the fall.

To secure the anchor for sea, a *ring-rope* is rove through the sheaves in the cat-head (the cat fall having been unrove), and the anchor-ring well greased—a tackle put upon it, and the ring of the anchor hove close up to the cat-head; a good lashing passed, and the cat-head stopper doubled and set well taut with a jigger. The end well secured. Put a good lashing round the stock.

The anchor is gotten as far in on the bill-board as it will go, by means of the fish fall and a thwart-ship tackle—before the cat-head lashings are secured—and good lashings passed around the arms, shank and bill. Triangular bolts and timber-heads are fitted for the purpose of lashing the anchor to. The shank painter is doubled and belayed.

The stock is gotten "up and down" by means of a tackle, before the lashing is passed round the stock and cat-head.

Now to get the anchor "off the bows," that is, ready for letting go, it is lifted off the bill-board with the fore pendant tackle and hand-spikes, the stopper and shank painter singled, and lashings taken off. The anchor, when ready for letting go, hangs by the cat stopper and shank painter.

[The Instructor should explain the meaning of all terms used in connection with working anchors and chains, such as: a long stay; a short stay; a peak; a trip; up and down; underfoot; veer; freshen the nip; surge, &c. &c. &c.; and should require the student to answer *any question* from the above, applicable to the School Ship, and also require him to *sketch* everything explained in the text which admits of it.]

CHAPTER XV.

SAILS.

[*From Boyd's Manual.*]

All canvas used in the Navy is flaxen, made in cloths of 40 yards in length, and in breadth of 2 feet and 18 inches. These cloths are rolled up in separate packages, called *bolts*. The stoutest being No. 1, from which the canvass increases in fineness, and diminishes in strength, to No. 8.

Sails derive their name from the mast, yard, or stay, upon which they are set; and excepting the jibs and spanker, are made up of 2 feet wide canvas.

In all square sails, the upper part is called the *head;* the lower, the *foot;* the sides, the *leeches;* the lower corners, the *clews;* and the upper corners, the *earings*.

In fore and aft sails, such as the spanker, boom main sail, trysail, the upper inner corner is called the *nock*, the outer the *peak*, the lower inner corner the *tack*, and the outer one the *clew*, or *sheet*. In such as jibs, the upper corner is the *head*, the outer the *tack*, and the inner the *sheet*.

The cloths are served with *sail twine*, the seams being double; those of courses, topsails, lower staysails, trysails, and spanker, are 1½ inch wide, and *stuck* (treble seamed down the middle of the seam); those of other sails are 1 inch wide. There are about 140 stiches to each yard; and one man can sew 100 yards in 9½ hours, single seam.

The foot of a course is *roached*, so as to clear the deck; and in all sails, those cloths which are cut in any *other direction* than straight across with the thread (or *woof*), are said to be *gored*.

Sails are supplied ready made, only requiring fitting with points, earings, bowline bridles, beckets, robands. Their edges are *tabled*, and stitched to the *bolt* rope. The tabling of large sails is strengthened at the clews and foot by a third fold of canvas sewn in it.

Small eyelet holes are worked through the tabling; and canvas and rope are then *marled* together. The roping of the clew is stoutest; tapering off to the leech rope. The foot rope is wormed, parcelled, and served.

In square sails the rope is always served on the after side; in fore and aft sails, on the port side.

The sails are strengthened with additional canvass at those places most exposed to strain and wear; in square ones, in the wake of cringles along the leeches on the foreside, called *lining;* in the wake of buntlines on foreside, called *buntline cloths;* across the foreside, called *reef* and *belly bands;* and in the case of top-sails, on the afterside, called the *top-linings.* Fore and aft sails are strengthened at the clews by *tack pieces;* and jibs sometimes with a *strain band.*

The *eyelet holes* are all bound by a grummet; those for robands and points are placed alternately two and one in the head, and two upper reefs; the third and fourth reefs have two in each cloth.

The *clews* of courses are formed with a stouter piece of rope than the foot rope or leach; its ends being tapered and spliced into them about four feet above the clew.

The *foot rope* of topsails is carried round the clew, and tapered into the leech rope in like manner.

The *clew thimbles* are seized in; those of the earings, reef tackles, bowlines, &c., are fastened with bolt rope strands; which are worked round the leech ropes through eyelet holes in the tabling.

Courses have two reef bands on the foreside, each being 1-6 the depth of the sail in the middle from the head; with a belly band half way between the lower reef and foot.

Topsails have four reef bands, on foreside, the lower of which is at half the depth of the sail; the belly band, also on the foreside, is half way between the lower reef and the foot. All top-gallant sails have three bowline cringles, the foot rope is spliced between the two lower ones, and is served and marled a short distance in leech and foot.

Were a sail to be exactly square, there would be little art in cutting; but as a ship's sails are, mostly, anything but square, there is much skill required in the arrangement of every cloth. In cutting out, and making them up, it is a primary object to adapt and cut the numerous gores which,

when brought together, will produce the form required, with the least possible waste of canvas; and this has been obtained by the long study and practical experience of the master sail-makers in her Majesty's dock-yards, as the waste canvas in cutting out a large suit of sails is trifling. This is effected by their method of casting the number of inches contained in each gore, so that when they are brought together they shall be equal to the number contained in the after leech cloth; this is in reference to fore and aft sails, but the same theory applies in the parts of square sails.

The bolt rope served on the hollow or straight leeches of square sails (or marled on their foot), is put on with sufficiency of slack canvas to admit of that stretch of rope which arises from the action of the wind, or the constant strain or pull upon the margin of such sails; and the necessary allowance for the stretch of the whole is made in the calculation of dimensions of such sails. But in the leeches of fore and aft sails, as also in the round foot of jibs, spankers, &c. &c., a sufficient quantity of slack rope is introduced to keep the foot from curling up to leave the after leech of these sails free, and also to compensate for the amount of stretch those parts of the sails above named are constantly liable to.

Spankers are made with an allowance to stretch of 3½ inches in each 3 feet of the foot, 1½ in each 3 feet of the head, and 2½ in each 3 feet of the length of the leech.

Sails are always bent to their yard or gaff with the roping next the spar, otherwise the stiches would be cut through by friction.

Sails are *pointed* by putting the ends of the pairs of points, from opposite sides of the sail, through the eyelet holes, reeving the ends through each other's eyes, and hardening them together with sheaves.

Many sails have latterly been fitted with *beckets* in lieu of points, the points being secured to the yard. These beckets are differently formed.

One way is to put both ends into the same hole from the foreside, knotting them on the after. Points jamb in these. Another way is to form the loop wider, by making it reach from hole to hole, knotting as before. This mode wrinkles the reef band, and prevents it from being hauled out taut.

A third plan is to have a line fast from cringle to cringle

across the after part of the reef bands, and to form the beckets on the foreside with another line, one end of which is made fast to the cringle; the other is rove through the first eyelet hole, passed twice round the after line, out again, and so on across the fore part, and made fast to the opposite cringle. On the same principle, some put the bights of the foremost lines through the holes with a hard kink, reeving the after line through the kink. This is more quickly done, and nips harder.

A fifth plan is to weave the two lines different ways right across, in and out of the holes, stitching the crossings. Either of these three last answers well; a great objection to the two first is that there is nothing to lay hold of abaft the sail. The great advantage of beckets is that the sails sheet home without fouling as do reef points.

The points are made split far enough down to admit of being toggled. They and the toggles are generally secured to the jack-stay; but if the jack-stay carried away, and the earings held on, the yard would most probably go on top, in the slings. For this reason, it is best to make the points long enough to go round the yard, reeving through their own eye underneath and abaft the jackstay. In some ships two jackstays are fitted, with a view of keeping the reefs more distinct.

A comparison of weights between reef points and beckets is greatly in favor of the latter. Thus, in a suit of sails for a first-rate, the weight of the points would be about 10 cwt., whereas the beckets and their appurtenances for a similar suit, would not exceed 4½.

Unquestionably, all topsails and courses should be fitted with *reef lines*.

It is well to fit all fore and main topsails alike, as to length of points in the different reefs, in the event of having to use a fore topsail on a main topsail yard.

Sails are sometimes made use of for the purpose of stopping leaks by *thrumming* them, as in making a mat. A quick way to prepare a sail for this purpose, is to pour hot pitch on it, and then tread oakum over it.

SAIL TACKLE.

It is our business to handle spars and sails under such very different circumstances, that it is impossible to make a law for the arrangement of the sail tackle and its fall as usually worked. The sail tackle is heavy, and supposed to be strong enough singly for shifting topsail yards with, but although equal to the *weight* of these spars, experience has shown that it is not able to stand the heavy and sudden strains which are thrown on it when the spar butts, as it so often does, against the tops, and consequently the long tie is generally used in addition. This plan is not only safer, but, on an average, quicker. The tie is so strong that the sail tackle may be rove of lighter rope, and kept in the top altogether without inconvenience. Round it up long enough to reach from the topmast head to the lower cap, and coil it on the top battens; send the fall on deck, place it in a constant lead and keep it coiled up in a rack. In large ships the main deck is the best place for the fall, as there is not only more *run*, but the men will be less exposed in shifting yards. Thus every one will know where the sail-tackle fall is, and when in any case the tackle is used aloft, the fall may be worked without delay or mistake. Fit a strop on the topmast head on the side opposite the long tie, and stop it along the legs of the stay. Keep a rounding line with a weight on its end coiled down on the lower cap, and a tricing whip from the topmast head inside the rigging, for the sail tackle.

In shifting yards, the lower block of the tackle, when triced up, will be flush with the yard. If for sails, the rounding line is hooked on to the lower block, and the end thrown down to the deck, before or abaft the main yard, or through lubber's hole, as the case may require. As with the sail tackle thus worked, nothing can be done with the rounding line until the yards are down, the topsails should be lowered as soon as possible, and the weather clew line run up.

BENDING SAILS.

Fit all the square sails with gaskets; seize them on their head at equal distances; make the lanyards a fathom long;

and put marks with knots, so that when hailing the yard from the deck, the gasket that may be alluded to can be denoted by its number from the bunt.

SAILS.

By tying sails up with temporary fastenings, there is not only great waste of spun yarn, but injury done; for ignorant hands always cut *at* the sail in cutting loose, instead of entering their knife and cutting towards themselves. It will prevent many vexatious mistakes, if the courses are marked at the bending places of the different gear with a piece of duck sewn on the sail bearing the initials of the particular rope which should be made fast there (thus, S. I. L., starboard inner leech-line, and so on); and also to plait some bunting into the robands at these places; for in sending courses up furled, nothing will go well unless the leechlines be fast to the head of the sail *exactly under* their own blocks, which are on the yards.

There can be no question about the superior neatness and efficiency of making it a habit to send sails, both up and down, made up just as if furled. Indeed, when blowing strong at anchor head to wind, there is no alternative.

In making them up, the main point to aim at is keeping the yard-arms as light as possible, so that the sail may haul out taut all along more easily. Lower the upper yards, and stop the yard-ropes out of the way.

Seize the *setting strops* to the heads of the sails at the middle eyelet holes; let them always remain there, and when using them after the sail is rolled up, carry the foremast leg round the after one, and seize its bight to its own parts. Topmen are very apt to cut this seizing too soon, but by having the strop fast to the head, their mistake may be partly remedied by a pull on the sail tackle, which is always hooked to the after leg.

TOPSAILS.

Haul the head of the topsails along the deck, after sides downwards; gather all the slack canvas back from the head;

lay the second reef-band along the head, and haul this and the head taut fore and aft by the earings Bring the leeches as far as the reef-tackle cringles along the head; knot the fourth reef earing into the third reef cringle, and the third into the second; carry the clews into the quarters about six feet over the head; bring the buntline toggles about a foot over the head between the clews; coil all the remainder of the ropeing so as not to ride, leaving the bowline cringles out; face the foot, and gather up; then face the head and roll up; pass the gaskets taut; stop the clews up abaft the head, after having passed them over the fore part of the bunt; seize the strop; hook the sail tackle; knit the second reef earing into the first reef cringle, the first into the head; and stop the head earings along the top of the sail on each side. Send the buntlines down on the same side of the lower stay with the sail tackle. Toggle them, and then hitch their bights round the quarters of the sail on their own sides about a fathom outside the strop. Bend a bowline of the side to the strop of the sail tackle block, to guy it off the top rim. When the clews of the sail have been swayed above the top rim, and the turns slewed out, take turns with sail tackle falls and buntlines. Bend the reef tackles to the second reef cringles; and keep a good strain on the buntlines as the sail tackle is lowered on hauling the reef tackles out. If the quarters are allowed to get below the yard, they are not easily raised. Carry the head earings out to the yard-arms; haul the head of the sail taut along the yard; tie the robands; lash the clew lines, shackle the sheets, bend the reef tackle to its proper cringle; toggle the bowlines; cast the hitch off the buntlines and the seizing off the strop; toss the sail up, &c.

COURSES.

Haul the heads of the *courses* taut along, roping downwards (*i. e.*, after sides on the deck,) on top of the setting strop, and make the earings fast. Gather the sail back from the head and then lay the second reef band on the head, hauling its earings also taut out. Bring the leeches in taut, as far as the inner leech line cringle, and lay them on the head. Lay the clews over the head, about six feet on each side of the middle of the sail, and the buntline toggles about

a foot over the head between them. Place the men along the head, and gather up as in furling; throw the skin over; let the men step across and roll up, pass the gaskets, footing them well taut; let go the earings, coil and stop them up; pass the foremost leg of the strop over the bunt of the sail, round the after leg of the strop, and seize its bight to its own parts. Make the stay whip fast well up on the slings, and hook on to the after leg of the setting strop. Sway the sail up and down, till its after part is aft, and when clear of turns, hook the reef tackles to the second reef cringle *over the tacks and sheets*, and haul the arms out to the sides, lowering the whip sufficiently to bend the buntlines, leech lines, tacks, sheets, and clew garnets. Hang the clews to the strop of the whip block before the bunt of the sail. Get the distance of each leech line block on the yards *from the slings* with a piece of line, and rack the leech lines to the heads of the sails, *exactly* at those distances from the middle of the sail, taking care that the leech lines are clear of each other and the inner one racked inside the outer.

Overhaul the clew garnets, and tacks, and sheets, well. If bending all together, trice booms up, sway the courses close up with the stay-whips, and the topsails with the sail tackles. When the clews of the topsails are over the top rims, send sail-furlers aloft, man the reef tackles and leech lines, lay out, and haul all the sails out together.

If the leech lines have been racked just under each leech line block, the courses will haul taut along the yard, so that two hands might bend the courses. Round up the clew garnets, bring to the heads of the sails, cut the seizing of the setting strop, leaving the strop on the head, pass the lanyards of the gaskets round the jack stays.

When the robands of courses are made longer than usual, they answer quite well for reef points, and on all the yards it is very convenient to have two on each quarter, long enough to pass round the sail when the gear has been so ill bent as not to haul it quite taut along the yard.

SPANKER.

Sway the gaff three feet up, guy the peak a little to the side on which the sail lies; make the guy and halliards fast.

Secure the head earing by putting in two eyebolts or "lugs," some two inches apart on the under side of the jaws, score the wood out between them, put the head cringle in edgeways, run a bolt or toggle through all, and seize it; lay the head of the sail along the gaff, passing it through the brails, but by *no means allow it to be stretched in the very least degree.* Lace from the throat, and *then* make the peak earing fast with up and down and outer turns. Let go guys, vangs, brails, &c.; sway the gaff up, seizing the hoops on *above the reefs* as the sail rises. Reeve a soft, greasy lacing below this, make the tack fast on the boom close to the mast, and hoist the luff up well taught. Put a light whip on the boom near the end, gather the sheet of the sail out, top the boom, and reeve the outhauler through whichever of the reef cleats on the boom the sheet, when barely hand taut, reaches; if it is short of them, lash a block on the boom for the purpose, and bend and take through the slack of the outhauler; then raise the peak, belay and rack all the halliards, and let the sail hang thus as long as convenient. As it is used, it will now give out equally all over, the outhauler being proportionally shifted out, and it will stand as well as any canvas not cut on the thread can do.

Seize the brails on the after leach in their exact places the first time the sail is hauled up, as before described.

TRYSAILS.

Trysail gaffs are usually fixtures, or "*standing.*" In some cases the pendants by which they are hung are carried out to the point of the gaff, and the head of the sail, instead of being laced, is made to run in and out on the gaff by means of hoops and out and in-haulers. They are said to be more manageable in this way.

HEAD SAILS.

Make the jibs up as if they were furled; mark the stays with a yarn at the "nips" at the boom ends, and overhaul them and the downhauls in on the forecastle. Unhook the reeving lines, and reeve the stays down from head to tack, and the downhauls up from tacks to heads through the crin-

gles; make the downhauls fast to the heads, and the reeving lines to the stays. Stop the luffs of the sails to the stays above the marks. Bend the halliards to the heads, and take a hitch with their bights round the sails, near the hanks, making fast with a seizing. Pull up the halliards, haul out on the reeving lines and downhauls, and lower the sails to their places; toggle the sheets, set up the stays, cast the hitch off the halliards, make fast the tacks, and reeve the lacings.

Lacings of fore and aft sails must be passed from the sail round the *fore part* of the stay or spar only; *not* in round turns.

Carry the *Staysail* out by the halliards and downhaul, seize the hanks on outside and toggle the sheets.

TOP GALLANT SAILS AND ROYALS.

Lay the yards on deck; bring the sails (roping next the yard) to the jackstays with the robands, and to the yard-arms with the earings, avoiding stretching by "riding down the head," &c., and keeping the turns of the top-gallant earings clear of the royal sheet sheave-holes; furl the sails, keeping the bunt low, leaving the bridles and clews out, and pass the gaskets well taut.

Send aloft and cross the yards, or put them in the rigging.

STUDDING SAILS.

The *Studding sails* are laced to their yards, furled square on their heads, tacks, sheets, and downhaul cringles being left out, and are tied up with centipede gaskets. On being bent, they are more tidily kept when stopped up and down the masts, and covered. On the booms they are "caulked" in, and in the rigging they hold wind, strain the shrouds, and have no chance of being kept dry.

It is usual to unbend studding sails if not much in use, bending them as required. The whole business of bending sails, has been often done without a word of preparation, in order and precision, in a line-of-battle ship, in fifteen minutes.

MAKING SAIL.

After bending, it is well to make all sail and move the yards about to show everything its place; getting braces, buntlines, &c., &c., marked so as to avoid occasion for unnecessary noise and delay in shortening and furling sail, squaring yards, &c., &c.

In sheeting home topsails, the sheets, if double, should be stopped together, having hands at the lower yard-arms, outside the lifts, to cut the stops when they have reached them; and in all cases before letting fall, the men should be warned off the outer quarters of the lower yards. The fall of the sheets is very violent, and the bights frequently get under the feet of the people on the lower yards. In loosing courses, it is not necessary to trice the booms up; and when the outer gaskets have been cast off, if there are no reefs to shake out, the men should come in off the yards; the booms and quarter-gaskets will keep the sails up.

When about to haul to a bowline, if there are reefs in, let fall first, and shake the reefs out. Before hauling out, warn people out of the fore part of the tops, and in all places where they are likely to be holding on by the buntlines.

FURLING SAILS.

The yards are usually marked on the quarters, so that the men may be kept within certain bounds before the order to *lay out* is given. If furling from a bowline, stop the bowlines, and haul them through before clewing up.

If working with "*beginners*," do not haul the buntlines up above the yards until the reefs are in; the state of the reefs can thus be seen. Indeed, to get the reefs well taken in, it is best, when all the furlers are aloft, to pipe reef topsails; "one reef," "second reef;" causing the topsail yard men to come in each time; and then if the reefs are satisfactory, pipe "furl sails," and "lay out" altogether.

Lowering booms the first ship is mostly an imposition, and in no case a proof of exceeding smartness. It is a mere matter of position of bunt becket. If that is low, or in other words, if the bunt be great, run the buntlines right up, having a hand stationed to ride each one down; pull up the bunt whip,

and lower the buntlines. The bulk of the sail falls into a huge unship-shape looking triangle, the booms are lowered, and the sails are said to be furled. But it comes on to rain heavily; the sails are filled with water, and as long as there is no opportunity for drying, we have drip on deck and decay aloft.

The sails are not furled in this case; nor are they, in any case, until every single man has done patching, and every man is down from aloft.

To furl a sail well, every cloth must be *handed;* that is, gathered up in handfuls; and each handful *stowed.* When this is done, let all hands lay hold of the skin all along; toss the sail up, bringing the skin as a covering over the upper side of it. The bunt, in this way, will be low and round. The end bunt gaskets are passed abaft the top-masts across to opposite sides, and down into the top where these are set up. The outsides only will be wetted in the event of rain, and will dry without even being loosed.

It is considered neat practice to cause all the men not stationed for squaring yards to quit the tops at the pipe "Down Booms;" and then when the upper yards are squared, to pipe the remainder down together.

The evolution is not completed whilst even one straggler is above the netting!!

The method of "making up" sails prescribed by Boyd is not generally adopted in our service. The following is the manner in which they are usually made up:

To make up a course. Stretch the head of the sail well taut along the deck, after side underneath; bring up to the head the belly-band, then the foot, leaving the clew blocks out at each end, also the bowline bridles, and roll taut up; pass the head earing round the sail close inside the bolt-rope, and put a stop of spun-yarn to every seam. The reef-earings are made up in the sail.

TO MAKE UP A TOPSAIL. Lay the sail on deck, after side underneath, and stretch the head of the sail taut along; bring the second reef-band up to the head, and lay all the points and earings snugly along; then bring up the belly-band, and then the foot. The clew-blocks, bowline bridles, reef-tackles and toggles for buntlines, should be left out, so that when the sail is sent aloft for bending the sheets can be

rove, reef-tackles clinched or hooked, and bowlines toggled, without loosing the sail, which will be found of great advantage when blowing fresh. Roll up, stop with spun-yarn at each seam, and expend the head-earings around the ends of the sail.

Top-gallant sails *can* be sent aloft by the royal yard ropes and bent, but they are usually bent on deck.

All spare sails should be *tallied* before being put in the Sail Room.

It is not usul to use a burton or sail tackle for bending a course; the buntlines are stopped to the head of the sail and answer the purpose.

Sails are sent down by the buntlines. The manner of unbending is given in Harbor Routine, page 35.

QUESTIONS—What are the sides of a spanker?

ANSWER —Head, foot, leach and luff.

What are the sides of a jib?

ANSWER—Foot, luff and leach.

QUESTIONS—How tell the forward from the after side of a sail? the head from from the foot? a foresail from a mainsail?

Why are sails "made up" on the *fore* side?

How are the sails of the School Ship loosed; furled; made up; bent; reefed; set; taken in; and unbent?

What is the objection, if any, to "making up" sails as directed by Boyd?

[The Instructor should now lecture upon the "Action of Wind upon Sails," as explained by Darcy Lever, or Boyd.

The Student should be required to sketch sails on the board, and point out the various parts, &c.

The manner of *taking in and setting sails* will be found in "Harbor Routine, Part 3. *Evolutions.*]

[Sails should be made up and *bent* in both the ways prescribed by the Text, in order to point out to the Student the advantages of both.]

CHAPTER XVI.

BOATS.

The Article in Harbor Routine gives the *commands*, &c, for hoisting in boats; the following, from Boyd, explains more particularly the *means employed:*

HOISTING IN AND STOWING BOOM BOATS.

The large screw ships have two launches, which must be stowed abreast, and well aft, clear of the funnel. In this case the booms, *i. e.* the spare topmasts, hand masts, fish pieces, &c., are stowed on each side, as close as may be safe to the funnel casing, and the crutches secured outside of them. The topsail yards lie under the boat outside these crutches.

The main-stay "looking" so much up and down requires no span; its pendant is run up through the fore part of lubber's hole, and hooked round the heel of the topmast to its own part, or to the main-yard slings.

The fore-stay pendant hooks to a strop underneath the after part of the fore-top, and is guyed aft to the main-top by a span, so as to *plomb* the place where the bow of the boat is to be stowed. The longer this pendant is, or, in other words, the longer the span, the better; and *every inch* is of value.

The runners or tackles are used for hoisting in heavy boats; but as the runner is inconveniently long, it is usual to reeve some spare rope as a launch's purchase. This is arranged in much the same way. A double block is spliced into a pendant, and the fall is rove through another double block, or else it is rove through a double and single, according to choice. The pendant is rove through either a smooth round thimble or a clump block, which serves the purpose of a lizard in guying the purchase out to the lower yard-arm. These are fitted with strop and toggle, or with double tails. The end of the pendant is spliced into a hook and thimble, and when triced

up, is passed over the cap and hooked to its own part. Lower reef tackles, when tailed, are very useful for tricing up runner tackles, and we have already said that topsail buntlines answer well for pendants. Heavy launches have four ring bolts at each end; and it is sometimes thought advisable to use not only the runners and stays, but also the yard and long tackles, distributing these tackles among the several ring bolts. It may be allowable to remark that there is a practical difficulty in keeping an equal strain on all, and that if the large tackles carried away, the small ones would not support the weight. However, it is certainly well, when there is much sending motion, to carry the main yard tackle forward, and the fore one aft in the boat; and in rolling, to have stout slip-ropes through the ports. Merely tossing a boat out or in, during fine or previous to bad weather, is such a trifling operation, that it seems unaccountable why boats should be left in the water for any considerable period, especially at night; but it becomes a grave affair when a heavy launch is sending in a sea way, from under the main yard to the fore; and too many precautions can scarcely be taken.

In securing the tails of lizards, they should be passed twice round the yard-arm, but not round the pendant. If a whip is used for tricing up, see that the end of the bend is so short that it will not get into the block. Place the yards. In large ships spread is a greater consideration than topping; in small ships it is necessary to top them. Put on preventer lifts or top burtons, and when the trusses and lee rolling or yard tackles are taut, pull all the lifts and top-sail sheets taut. Back the foreyard up with a tackle or two parts of a hawser from the bowsprit cap to the yard-arm; and when it is fast, check the opposite fore brace. Boom jiggers, especially the fore ones, are frequently forgotten in bracing yards in; and before the yards are secured, they should be so free from restraint as to look to their work in a straight line. In hooking on in the boat, see the turns out of the tackles; and in hooking on the stays aloft, remember that launches have come down in consequence of the stay having been hooked with a kink, although the hooks were of faultless construction and proportion.

Put luffs on the off side anchor stock and main rigging, for hauling the boat over with. If there is a choice, put the

short leg of the fore slings forward. The objection to short spans with rope applies also to chain; and slings may be lengthened with some stream chain shackles. Four hands will be sufficient in the boat, after she is baled out and prepared for hoisting.

Lead the falls so that the men will never be under the boat when she is over the deck. Have leading men to pass lizards, connect ends of purchases, stopper, and belay; as well as seconds to the belaying men, whose duty will be to "light to," whilst taking the turn, and pay the fall clear in lowering. Working on an upper deck, it answers well in coming in to put the men belonging to the fore part of the ship on the main yard, and those belonging to the after part on the fore yard, as, when the yards are high enough, all hands will be on their own station ready for stays or other duty.

Run the *slack* of the stays in as the boat rises, yet without bending her to the side. When there is much slack left to run away with, the chances are in favor of a bight getting well into the swallow of the lower block before the men can be stopped; the boat will then be carried in by one part of rope, and a heavy surge is then *inevitable*. The men in the boat must be warned to sit tight, and *then*, the stays let go. The higher the yards are hoisted, *the greater will be the strain on the fore-yard*. Commence easing in the fore-yard as soon as the fore-stay is bearing weight. When the keel is high enough to clear the crutches, haul over with the off guys. If the boat is required to go forward, slack the main-stay; if aft, the fore-stay. If there are two launches, hoist the off-side one in first; don't wait for a few inches as to fore and aft line; go on with the other, and complete the duty afterwards with the stays. In hoisting out, take the nearest launch first, for reasons mentioned above. The purchase should be triced up, and unhooked the instant it has done its duty, without waiting for stays, and the men who are stationed at the lizards should remain in the futtocks ready to inspect or disconnect their gear. If braces and tackles are satisfactorily arranged, put "bracing in," and "hoisting" marks on the gear, remembering that the higher the boat is hoisted, not only is there more time occupied, but the fore-yard is more strained. The officer carrying on forward is too frequently changed in his station to be enabled to tell by the eye; but a boatswain

of the genuine kind will pride himself on graging the waist nettings.

When hoisting out in a tide or sea way, have a boat rope passed from forward let outside all, and bent to the boat before she touches the water.

Yard tackle pendants become very much injured in the splice of the eye by wet, and the falls by chafe when kept aloft, besides being no handier than when kept on deck with a whip on the yard for their use. If kept on deck, fit the end with a thimble, in its bight large enough to take the hook. Make this strop long enough to go round the yard, bend the yard whip two feet down the pendant, and stop the strop up on the whip.

Top burtons are usually used for preventer lifts, and are difficult to carry out to lower yard-arms, especially when topped much. A spare lift, formed of a piece of thick rope having a hook and strop with a thimble at each end, has been found to answer well. This is kept middled over the lower cap. When required, one end is hauled out to the yard-arm by a small line, the strop passed round the arm and hooked, whilst the other end is set up with a lanyard in the top. If the topmen neglect making it very taut, the standing lift may be checked as the tackles are hauled taut.

Snatches on the lower yard-arms are convenient for scoring top-mast stud halyards in for yard-whips. Keep a hank on the halyard, with a line fast to it. Carry the line out to yard-arm; after cutting the stop of the halyards, haul out and score them; the end of the halyard being on deck, is all ready for bending on.

Barges and pinnaces are hoisted in with the yard tackles and stops alone; and, bearing in mind how frequent is this operation, and the constant exposure of this gear, every opportunity for examining the eye at the yard-arm, and the state of the falls and blocks, should be taken.

In very large sailing ships, the barge and pinnace are stowed on each bow of the launch, but in others all these are abreast, and so crowd the gangways that it is necessary to work many ropes on the main-deck. They may be fitted thus:

Put the launch in her place; stow the booms. Support her by curved crutches, the heels of which work in pairs of

lugs on the skid-beams, and the tops in clamps which fit on the rubbing-streak; these clamps have lugs, between which the point of the crutch enters, and is secured there by a pin through all parts; thus the clamp pivots and the crutch pivots. Have three of these crutches on each side of the boat, and let them be long enough to bear taut against her; fit all the thwarts of the launch and barge to unship; fit the stern gratings to ship on ledges fastened fore and aft, about eight inches apart. Let this vacancy be filled by a board when the boat is in use; the gratings are fixtures.

Put the barge inside the launch; her keel will enter between the grating ledges. Put chocks between the outside of the barge and inside of the launch, in the wake of the crutches. Put the pinnace inside the barge, and in like manner her keel will stand all along on the barge's kelson.

In making these arrangements, take care that the thwarts are not turned with the points of their finger-bolts downwards; and lay the oars on each side on the bight of a piece of rope from the gunnel, so that when the inside boat is out, they may be parbuckled up to the gunnel whilst the thwarts are being shipped.

In hoisting the launch in, the crutches are held nearly upright; and the clamps being turned back, their inside ends catch her side whilst being lowered, and drop in their place.

The crushing power and consequent security of these crutches may easily be shown by starting the chocks on which the keel rests; when borne by them alone, her sides would be actually stove in.

HANDLING BOATS.

(Boyd.)

When ordered on boat duty, it is well to remember your mens' meal hours, either taking the provisions in the boat, or warning the master-at-arms that the crew will be absent. See that the gear—masts, sails, oars, fenders, boat-hooks, bailer, anchor and cable, painter, flags, breakers, water, rudder, awning, and stanchions—is complete, and that the crew are properly dressed. It has been found very convenient to keep

a quarter-case in each boat, containing a pistol, flash-pan powder, caps, a rocket and blue light, hatchet, and a few nails, &c.

A boat officer is always supposed to have his spy-glass, watch, and signal-book at hand; and it is well to make certain that orders are rightly comprehended before leaving the ship.

If about to sail, get the sails taut up before shoving off; see that the yards are slung, so as to set the sail smoothly. Ship the rowlocks; make all the men who are not about to spring the boat off, sit down; haul up, sheer off; in fenders. As a general rule in sailing, insist upon the crew setting down on the bottom boards of the boat.

The hauling end of lug halyards is always long enough for a downhaul. Splice an eye in its bare end, and put this eye over the hook of the traveller before hoisting.

Keep your weights amidships, and never belay the sheets.

Before reefing on a wind, tell the men off for the different duties; the two bowmen to gather down on the luff; two weather hands by the halyards and downhaul; the lee hands to tie the points, one strokesman to attend the sheet, the other to assist the coxwain in reefing the mizen. No person need stand up. Neat two-handed boatmen never jump about on the thwarts or shove more than their heads above the gunwale. Do not luff up; chock the sheets; lower enough to shift the tack hooks easily; gather the fore sheet aft, that the men may reach the foot of the sail without leaning over the lee gunwale; shift the sheet; tie away; slack the sheet; hoist; resume places, and haul aft. Should the mizen be reefed more quickly than the fore-sail, do not haul its sheet aft until the boat has steerage wagon, else she will get in the wind and lose time.

In boom boats, set the jib before setting the fore-sail, taking care to have the runners hard taut before hoisting. The jib is the fore-stay; and if the fore-sail be set first, the mast-head is dragged aft, and the after-leech hangs slack. If obliged to set the jib after the fore-sail, ease the fore-sheet off whilst hoisting the jib, and let the mast-head go forward into its place.

In coming alongside, lay the fenders out, and get the bowsprit in in good time, especially if it be an iron one. The

general rule is to keep the main yard of the ship end on; but that must depend on tideway, and whether the boat is heavily or lightly laden.

The boat should be bailed out, slings hooked, and otherwise prepared for hoisting, before reaching the ship.

If your men are all sitting to windward in a breeze, make them occupy their proper places amidships before passing to leeward of a vessel. There is not only an eddy wind under the stern of a ship that is riding head to wind, but also frequently an indraught of water. And it is not uncommon to see an inexperienced young officer trying to pass close under the stern, suddenly taken aback, and his mast-head, which at one moment was looking quite clear of the boom, thrown to windward, and entangled by it.

Hailing or interchanging hails with the gun-room, on passing astern, is just as improper as the above course is foolish.

When the wind fails, get out oars at once.

The remarks about handling ship apply equally to a boat. You may bring her to such nicety of trim under sail, that in moderately smooth water she will go round without any assistance.

Putting the rudder right across the stern deadens the way; 420 is considered the extreme of efficiency.

When there is no way on, or when the boat is tied by the stern—as in tricing, when the tow-line is fast to the wrong place, as the stern ring bolt—the rudder has no effect whatever.

If your boat hangs in stays, and has just lost, or is about to lose, her way, you may (possibly) get her head round by a jerk of the tiller, but it looks very silly to be going through the motions of steering when there is no way on.

During sternway the rudder has a different effect to what it has when there is headway. If, when going ahead, you were to unship the rudder, and could point the stem, say three points on either bow, the bow would glance off in the direction towards which the stem pointed. It is precisely so with the rudder in sternway. If the helm is put a-starboard, the rudder points out on the port quarter, the water presses on the starboard side of the rudder, and the stern glances off in the direction to which the rudder points.

It must be observed that in sternway, when the rudder is

over to either side, much strain is brought on the braces and pintles. Consequently, when ships are taken aback in a squall or seaway, it is usual to secure the helm amidships.

In all cases of steering, endeavor, either by trimming sails or disposition of weights, to reduce the boat to what is called a "small helm;" that is, that very little effort will be required to move the boat's head either way. For when the rudder is dragged much across the stern, the way is retarded. Weather helm will be induced by allowing the boat to be pressed by the head, and this may be caused by the bowmen sitting forward, or by press of sail, or both. If the bows are clear, a pull on the jib sheet *might* relieve the helm, but not as a matter of course; for if the jib was already flat, it might be the cause of depression, and a few inches checked would, perhaps, answer the purpose. Then the mizen might be the cause, and an inch of that sheet might be the remedy. But it will be of no use to attempt trimming until the sails are taut up and well set; and then the officer in command can make his arrangements and alteration of trim, until the boat may be so nicely balanced that, by sending the bowmen forward and letting go the tiller, she will go about of herself.

Boats blown off the land, or otherwise adrift, have ridden out heavy seas by riding at their spars, which, after being lashed up in a bundle, were thrown overboard, with the cable bent span-fashion to them.

A boat will be got upon a beach more easily by placing the stretchers on thwarts under the keel; of course rollers are better. If you have blocks and rope, you can get a pull by burying your anchor, keeping a hand on it to prevent it from rising. Sea mud is as good as soap on the "ways."

You will get your boat under a low bridge, or under a weight that cannot be raised high enough to clear the gunnel, by taking the plug out.

When weighing anything heavy over the stern, bear the rope amidships, and step the awning stanchion over it. Otherwise, if whilst rolling, or from other causes, the rope flies over the quarter or side, the boat will fill.

When you are presented with the end of a hawser to run out, and which is not becketed, put a hitch on it and stop the end down at once.

When you go on duty to another ship, return to your boat

the moment that you have delivered your message, and wait for orders. If in a tide-way, ask for leave to hang on by the boom. A careless officer goes below; his boat's crew block up the gangway, commence conversing through the ports, are disrespectful to strange officers, and bring a bad name on their ship. When a boat officer must be absent from his boat, he should leave his coxswain in charge, with positive orders concerning his duty.

Towing. (Boyd.)

In taking another boat in tow, pass clear of her oars; place yourself right ahead, exactly in line, and "give way" the instant that you have hold of her painter. Do not give another boat *your* painter until she is in line ahead of your boat. Take the towline to the foremost stern sling bolt, and toggle the bight with a stretcher. If you wish to turn your boat's head, bear the tow line over the quarter on that side to which you desire to turn, for the helm will be of little or no use.

In towing short round, do not attempt to turn before your leaders are round.

The heaviest boats should always be nearest the tow.

Boats will tow with increased effect if weighted with shot. A few lengths of stream chain is the quickest weight that can be passed in and out, besides being less damaging to the boat.

Taking another boat in tow without delaying the duty by fouling her oars, or geting athwart her hawse, is a very neat performance for a young officer, and when well done betokens judgment and skill.

Saluting. (C. S. Navy Regulations.)

Boats not heavily laden, will, on meeting or passing other boats, observe the following marks of respect.

1st. To a boat bearing a flag or broad pendant, boats carrying narrow pendants will lie on their oars; all other boats will toss their oars.

2nd. To a boat bearing the narrow pendant of a captain of a frigate, all boats will lie on their oars.

3rd. Officers in boats meeting or passing their own immediate Commander, with a pendant on his boat, will salute him by lying on their oars.

4th. All officers in boats will touch their hats to each other when passing, and boats saluted will return the salute by tossing the bow oars.

5th. The same marks of respect are to be paid to boats carrying foreign officers as to our own.

BOATS DETACHED. (Boyd.)

Make due allowance for the rate at which the tide is going past the ship, or the rate at which she may be moving, when making for her. A current frequently sets close along shore in the opposite directiction to the one that is going by the ship; and therefore, a little judgment may save a long pull. At Spithead, for instance, when the ship is swung at ebb, with her head to the Eastward, the tide will run strong *towards* that direction along Southsea Beach, and a boat pulling straight for the ship from the harbor would be carried very much astern; whereas, by dropping down with the tide, close along Southsea Beach, until well ahead of the ship, very little effort will carry the boat on board. An inquiring boat-officer will learn more of the theory of local tides and currents by a chat with a waterman, than can be found in books; and by observing—when abroad—the manœuvres of native boatmen, much labor and risk will be avoided.

When watering with casks, keep slings on those which stow amidships. Keep the end of the Suction hose in a washing tub, or place a piece of bread-bag stuff round the *rose;* for a very little gravel drawn into the valves will delay the work. Do not forget the engine wrenches and bungs.

When watering in bulk, wash the boat well out the first thing, and when being towed off, do not allow boat-keepers to sit smoking on the gunwale, forgetting to spit overboard.

A forty-two foot launch will carry in bulk, in smooth water, about 22 tons of water.

In rafting casks, knock the inner hoop off each end, and drive them on over a hide or sennit becket. Stop the raft line to these beckets, but do not reeve it.

In the entire absence of usual resources, great weights, such as a gun, for instance, may be got in a boat where there is a rise and fall, by filling the boat with dunnage, at low water, or sand, banking up an inclined plane with shingle, rolling the gun into the boat, clearing out the sand, and waiting for the tide to float her off.

When boats are riding at the booms, the best stern fast is a whip from the main yard with a light inhaul.

Boats may be kept clear of the ship, when riding astern, by causing them to tow a grating, or bucket, or net full of shot.

If it comes on to blow when you are detached, you will most probably be signalled to remain where you are till it moderates. If you return, either round to ahead, down masts, out oars and drop down; or else, if you have confidence shoot up under the stern.

Meeting on opposite tacks, the boat on the port tack passes to leeward. Boats running give way to those on a wind. Never stretch the heads of your sails in bending them, put them to the yards and gaffs barely hand taut.

In shoving off when the ship is not head to wind, pull well clear of her before making sail.

Remember, in running, that you cannot carry all the canvas on a wind that you can before it; therefore make ready for rounding to.

Running with much sail dead before it, in a gig, is very dangerous: if the wind comes a little on the sheet quarter, (say starboard,) it is safest to haul up to port; and when the wind is on the port quarter, haul in the sheet, lower, shift the sail round, resume course, and hoist the sail on the port side.

When you want a pull on the halliards, let go the sheet; if in the fore, check the mizen at the same time.

Dipping a lug is the neatest handed affair a boatman has to do. You must tell the men off; the bowmen to bear the fore part of the sail out, the two next to gather the sheet of the sail forward and pass it round, the after hands to unhook and hook the sheet, the others to sit fast, shifting the halliards and handing the foot along, and hoisting when ready. Do not lower until the fore part of the sail has been aback sufficiently to bring the wind on the other bow, unless it is smooth and you have great way on; but the sheet may be

unhooked the moment the sail lifts. Keep your halliards with a mark, so as not to lower the yard more than is necessary for dipping the after yard arm; you will have more back sail to carry you round, and less slack sail on top of the men. Attend the mizen sheet in case the boat should "come to" whilst re-hoisting the fore sail.

HOOKING ON FOR HOISTING.

When there are eyes in the tackles of quarter boats, and hooks in the "Slings," the thwarts and boat-keepers are not fished out of the boat. When it is hooked, the keepers should hold the block taut up by the standing part of the fall; the steadying lines are secured to eye-bolts in the gunwale. When the ship is sending and rolling, you should cross the life lines, and have hook ropes fast to the slings from the ship through the ports, well attended, so as to bind the boat as she rises to the side; the lower deck ports should be either lowered or triced back. Send all your crew, except four at the mast, out of the boat, make them go up by the chain ladders, and not on the life lines. When the boat is up, pass the bight of the life line through the slings over the davit end twice, and hitch before attempting to belay the fall. Pass the gripes round the boat clear of turns. Have squaring marks put on the falls, so that she may always sit square on the davits. Ship the rowlocks and rudder. If there be no scuttle which opens of itself, take the plug out the moment the boat leaves the water. Send the end of your cable and make it fast as far forward as possible outside all, and stop it up to the chains with cut yarn. In hooking on, hook the foremost tackel first, and on being lowered, unhook the after one first. In a tide way, or when there is way on the ship, dangerous accidents may happen from inattention to such precaution. See that your fenders are in, fill your water-breaker, and if the weather be hot, put the cover on square and smooth during the day, taking it off at night. In a stern boat, in a tide way, or ship going ahead, do not attempt to haul across the stern, or hook the stern tackle, until all is ready on deck, and then hold hard by the life lines, for the boat will suddenly fly forward. In blowing weather, or heavy tides, if a small hawser be carried round the ship out-

side all,—the bight being made fast to the bowsprit cap, suspended on both sides from each lower yard-arm and spanker boom end by whips with bowline knots and the ends reaching the water astern,—boats may not fear to make for the ship anywhere without running against her; for whilst the hawser is out of the gangways, triced up when not in use, the quartermaster of the watch can drop it on top of a boat, and avoid the frequently too late cry for a boat rope. Wet warps require careful seizings. Whilst hauling ships about the harbour, we never see the warps laid out by the dockyard riggers, (however wet,) slip or come adrift. Their plan is worth notice. They make four parts of their spun yarn seizing, take a round turn with the bight of this round the standing part of the hawsers, then pass the seizing, (figure of eight fashion,) round the hitched end and standing part, then cross it opposite ways with two parts each way, reeve the ends through the bights and drag all the turns taut.

A quick way to preserve warps or small cables from injury, is to reeve them through your spare gun trucks, clapping a "bear a hand" mousing on each side. Boats should have their particular recall, the general recall, their distinguishing pendant, a "pull to starboard" pendant, a "pull to port" pendant, the "answering" pendant, and a "you go very well" pendant, painted on a board fastened on their inside in some safe place. Boats may be manœuvred with much effect with these few "general signals." Before going alongside a vessel under weigh, observe if she have head or sternway, and in any case get the masts down before closing her; otherwise, if the bowman fail to catch hold, and the mast-head be fouled, a capsize is nearly a certainty. A metal crutch fitted to each boat to ship on the stern, so as to steer with an oar when the rudder is wanting, is a most useful "stand by." Numerous rope ladders facilitate boat work materially. Stern and quarter ones are indispensable. Having quarter and stern boats' tackles kept overhauled down in the absence of the boats, prevents delay in hoisting, dispenses with an unsightly pile of gear in the mizen chains, and is a great saving of men's clothes, who otherwise must soil a suit in stopping up. The quarter tackles may be becketed to eye-bolts in the bends, keeping clear of port edges, else they chafe; and the stern tackles to the rudder bolts. In being towed by a vessel, if

alongside, contrive to have the rope from as far forward as possible, so as to avoid riding at a short stay; never make it fast, but toggle it with a stretcher through the aftermost of the foremost sling bolts, so as to be able to slip it in an instant. Steady it near the stem with the bight of the lazy painter passed over it. If being towed astern, the closer the better. And when about to be cast off, either be dropped astern clear of other boats, or be handy with your oars, so as to shoot out clear of other boats which may be in tow. Do not permit other boats to hang on by your boat. If other ropes are not supplied, get more of your own tow-line, and after securing its bight, as before said, pass its end aft; and if it is not long enough, bend the nearest boat's warp on to it, otherwise your stern or stem will be dragged out. The quick way to run a short warp out, is for one boat to run away with the end, and the others to pull in fore and aft under the bights as they are payed out at equal distances according to the length of the warp and number of boats, giving way the moment they have got hold. In all cases, when you take in the end of a warp, coil enough of it forward, so as to be able to make a bend the instant your boat reaches the place you wish to make fast to. It is hardly possible to lay a heavy warp out without floating its bight. If there is a chance of its being suddenly tautened, hang it outside the boat, instead of laying it fore and aft amidships. In running warps out, the whole warp is sometimes coiled in the boat, and the end being made fast to some desirable place, the boat makes for the ship; in other cases, a part only is coiled in the boat, and she carries the warp from the ship to the place to which it is to be secured. Whichever way it be there is great judgment required in reserving a sufficiency of hawser in the boat to ensure that she will reach her destination, only paying out when certain of doing so. It is from this necessity for judging the distance by the eye, that we have the term "guess warp."

Stern boats are best fitted when they have runners as well as tackles, the runners being passed after the boats are hoisted up by the tackles. The tackles are then unhooked, and the boat is lowered by the runners. All standing parts of gripes of outside boats should be fitted with slips, the falls kept in separate racks, and one boat's binnacle, at least, kept on deck ready for use.

CHAPTER XVII.

ORGANIZATION.

The organization of a ship's crew is attended to by the 1st Lieutenant, or Executive Officer.

Upon being ordered to a vessel, the Executive Officer visits the "Receiving Ship," and finds a crew already detailed by the commanding officer, as directed by the Navy Regulations, CHAPTER 32, *page* 170.

He examines the men, and selects the petty officers; also the topmen, fore-castlemen, and after guard. Upon receiving them aboard, he makes out his watch, quarter, and station bill, and assigns to each man his station.

Every man has his ship's number, watch number, and hammock number. The ship's number is the number given the men by the Pay Master on his rolls—the watch and hammock number should be the same, and assigned by the Executive Officer.

The men are *messed* by the Master at Arms, under the superintendence of the Executive Officer—the petty officers having a mess to themselves.

Bags and hammocks are issued by the sail-maker; lashings by the boatswain—always by direction of the Executive Officer.

The bags are stowed in *racks*, and the hammocks in the *nettings*.

The hammock hooks are put up at the yard, and numbered by the Executive Officer. The watch or hammock number of each man assigns him his *berth*. The numbers are so arranged that the men are *berthed* near their stations: fore-castlemen forward, topmen amidships, and after guard aft; petty officers near the hatches.

Hammocks and bags are numbered with the watch numbers of the owner.

Watch, quarter and station bills are made out by the Executive Officer, in accordance with the complement of the

ship; and the men being received in the morning, should be mustered at evening quarters, as though the ship had been three years in commission.

At the first of every month the Division Officers make out Clothing and Requisition Bills, which are approved by the Captain and issued by the Pay Master.

The Fire Bill is made out by the Executive Officer, and posted as soon after the vessel is put in commission as possible.

It is customary for the Executive Officer to prepare and publish a Daily *Routine*, for the guidance of the Officer of the Deck. A *Routine* is only absolutely *necessary* where the officers placed in charge of the deck are young and inexperienced. The best form for *Morning Orders* is undoubtedly to "call the First Lieutenant at daylight." After reaching the quarter deck he can issue his orders for the day.

A Conduct, or Liberty Book, is kept by the First Lieutenant, in which to note down all offenders, so that they may be brought to punishment.

To properly organize and discipline a ship's company, it is absolutely necessary that the officer charged with it should have had considerable *experience* on board a man-of-war. No amount of *book learning* will enable an officer to become a good First Lieutenant.

Midshipmen should keep copies of the watch, quarter, station, and fire bills of the ship serving in, for future reference.

The Ordnance Manual prescribes the manner in which the crew is to be quartered. Forms for Watch and Station Bills are sometimes furnished by the Navy Department.

The following is a copy of a Fire Bill for an iron-clad, mounting four guns:

FIRE BILL.

Upon the alarm of *fire*, signified by the ringing of the ship's bell, all hands will at once repair to quarters; but the ordinary call is to be given as soon as practicable, by way of enforcing the order.

The *Firemen*, with their battle axes, in charge of Midshipmen ——, will lead along the *hose*.

The Pumpmen will man the *pumps*.

The 1*st and* 2*nd Captains* of Guns will constitute the *Fire Party*, under the First Lieutenant and Boatswain; which latter officer will have the axes at hand. They will remain at quarters until called for.

The *Carpenter and his mate* will immediately rig the *pumps*, assist in leading out the *hose*, and provide axes, &c.

The 1*st and* 2*nd Spongers*, under Lieutenant ——, will constitute the *Smothering Party;* will provide themselves with blankets and wet swabs, and remain at quarters until called for.

The *Compressor-men* and 2*nd Train-tacklemen*, under Midshipman ——, will get up buckets and swabs.

The *Powder Division* will form lines for passing water.

The *remainder of the gun's crews* will, under their respective officers, run in the guns, form lines for passing water from outside, cover hatches, fill up division tubs, wet blankets and swabs, &c &c.

The *Master* will take charge of the spar deck, and, with his division, put on gratings and tarpaulins, lower windsails, superintend the lowering of boats, form lines for passing water, &c.

The *Gunner and Quarter Gunner, stationed in the Magazine*, will repair to the cocks for flooding the *Magazine and Shell Room;* and will await orders from the commanding officer.

All men stationed in the Shell-Room, Bolt-Room and *Shot Lockers*, will repair to the *Gunner's Store-Room*, and await orders as to throwing the stores therein overboard.

The *Quarter Gunner, stationed at the Magazine Screen*, will repair to the *Rocket Locker*, and await orders.

The *Quarter Gunner, stationed at the Battery*, will repair to the *Musket Rack* and *Division Boxes*, and await orders.

The *Lieutenant in charge of the Gun Deck* will give orders to draw the charges, throw shell overboard, &c., when in his opinion it becomes necessary so to do.

The *Master at Arms* will report to the Executive Officer for orders as to the release of the prisoners.

The *Chief Engineer* will detail such assistant Engineers and men as may be needed to take charge of steam pumps, lead out hose, &c.

The *Surgeon and his Assistants* will be in readiness to destroy, if required, all inflammable fluids; and will superintend the removal of the sick. His post will be at the Dispensary.

The *Pay Master and his Clerk* will attend to the saving of the money, books, &c., in his charge.

The *Marines*, in charge of their commanding officer, will form on the upper deck, with loaded muskets; sentries must be at once placed over the *Spirit Room* and *boats*, with orders to allow no one in each without orders from an officer.

If the alarm is given at night, the men are to await orders as to the disposition of their hammocks.

All officers not specially mentioned are to remain at their quarters, and assist in forming lines for passing water, preserving silence and order, &c.

The following "instructions," though not probably belonging to *Seamanship*, will, perhaps, be found useful. They were adopted, with success, by the Division Officers of the Steam Frigate Merrimac, on her last cruise, in instructing the men at quarters. More questions are asked, however, than men can be expected to answer; and some have lately been added. They are given here simply to point out to the young officer a *method* of instructing his Division, and can be modified at pleasure.

Men get very tired of running the guns in and out, and the gear soon gets "long jawed;" by pursuing a proper course of instruction, though, the crews become very much interested.

Beginning with the *First Instruction*, the officer requires the men to answer to their duties at "casting loose," "securing," &c.; he calling the *numbers*. He then goes to the *Second Instruction*, and so on.

In the following, the *First Instruction* applies to the 9-inch gun, on the Marsilly carriage.

In the other Instructions the officer asks the question, and then *answers it himself*, dwelling upon it until every man at the gun understands it. Many of the questions should be omitted, as too difficult:

FIRST IRSTRUCTION—9-INCH GUN.

Casting Loose.

No. at Gun—1. Cast loose and middle breeching; place straps and toggles amidships; give lock apron to No. 11; equip with belt, primer-box, thumb-stall, priming-wire, boring-bitt, cutlass and pistol. See gun clear for action, and report.

2. Cast loose and middle breeching; clear lock-string; place sight covers, straps and toggles amidships; provide match. Equip with belt, primer-box, thumb-stall, priming-wire, boring-bit, cutlass and pistol.

3. Place swab and chocking quoin near ship's side; assist No. 4 to take out tompion; cast loose. Arm with cutlass and pistol, or sword bayonet.

4. Place chocking quoin near ship's side; take out tompion and pass it to No. 6; assist in casting loose. Arm with cutlass and pistol, or sword bayonet.

5. Assist in casting loose; place shot-grommet, shot, and wads, in rear of gun, to the left; hook and house the double block of side tackle. Arm with cutlass and pistol, or sword bayonet.

6. Assist in casting loose; hang tompion amidships; take down sponge and rammer; hook double block of side tackle, and mouse it. Arm with cutlass and pistol, or sword bayonet.

7. Provide shot and shell arms: Pike.

8. Provide shot and shell arms: Pike

9. Provide ordinary and roller handspike; assist in casting loose. Arm with cutlass and pistol, or sword bayonet and cartridge box.

10. Provide ordinary and roller handspike, and bucket of sand; assist in casting loose. Arm with cutlass and pistol, or sword bayonet and cartridge box.

11. Put lock-apron amidships; hook and mouse train tackle; see fire bucket and battle lantern in place. Arm with battle axe.

12. Hook and mouse train tackle; assist in casting loose. Arm with sword bayonet and cartridge box.

13. Assist in casting loose: fill water bucket; stow hammocks at night. Arm with a battle-axe.

14. Assist in casting loose; stow hammocks at night. Arm with sword bayonet and cartridge box.

15. Assist in casting loose; clear away port tackle. Arm with sword bayonet and cartridge box.

16. Assist in casting loose; clear away port tackle; provide wet swab. Arm with battle-axe.

17. Provide passing box for powder.

Securing.

No. at Gun—1. Secure breeching; coil lock-string; put in vent-plug; return equipments, and report gun secured.

2. Secure breeching; put on all aprons; return equipments.

3. Put in tompion; assist in securing; return implements and equipments.

4. Put in tompion; assist in securing; return implements and equipments.

5. Replace shot-grommet and wads; assist in securing; return implements and equipments.

6. Hand tompion to No. 4; return rammer and sponge; assist in securing; return equipments.

7. Return shot, shell, and empty boxes; assist in securing; return equipments.

8. Return shot, shell, and empty boxes; assist in securing; return equipments.

9. Return hand-spikes; assist in securing; return equipments.

10. Return hand-spikes and bucket of sand; assist in securing; return equipments.

11. Secure train tackle; put lantern and fire bucket in place; return equipments.

12. Secure train tackle: assist in securing; return equipments.

13. Assist in securing; return equipments.

14. Assist in securing; return equipments.

15. Secure port tackle; swab deck; return equipments.

16. Secure port tackle; swab deck; return equipments.

17. Return passing-box and powder.

Shifting Trucks.

No. at Gun.	PORT TRUCK.	STARBOARD TRUCK.
1.	Roller hand-spike.	Roller hand-spike.
2.	Roller hand-spike.	Roller handspike.
3.	Shift truck.	Place chocking quoin and
4.	Place chocking quoin and man hand-spike.	Shift truck.
5.	Get new truck.	Man hand-spike.
6.	Man hand-spike.	Get new truck.
7.	Man hand-spike.	At station.
8.	At station.	Man hand-spike.
9.	Man hand-spike.	At station.
10.	At station.	Man hand-spike.
11.	At station.	At station.
12.	At station.	At station.
13.	Man hand-spike.	At station.
14.	At station.	Man hand-spike.
15.	At station.	At station.
16.	At station.	At station.
17.	At station.	At station.

Sponge, Load, and Shift Breeching.

No. at Gun—1. Serve vent.

2. Unshackle old, and shackle new breeching at breech load.

3. Load.

4. Sponge and load.

5. Pass cartridge and shell, and draw breeching-bolt.

6. Pass sponge and rammer, and draw breeching-bolt.
7. Pass shot or shell.
8. Pass shot or shell.
9. Bring new, and take away old breeching.
10. Bring new, and take away old breeching.
11. Assist in shifting breeching.
12. Assist in shifting breeching.
13. Draw side shackle-pins.
14. Draw side shackle-pins.
15. At station.
16. At station.
17. Pass powder.

Dismounting.

No. at Gun—1. Take out screw and light-bar; remove breeching, and tend at breech.
2. Adjust "griolet," and tend fall.
3. Chock carriage, and tend at muzzle.
4. Chock carriage, and tend at muzzle.
5. Draw breeching-bolt, and man fall.
6. Draw breeching-bolt, and man fall.
7. Take off cap square; out side-shackle pin; and man fall.
8. Take off cap square; out side-shackle pin; and man fall.
9. Key "griolet bolt" on upper deck, and man fall.
10. Adjust "griolet," and man fall.
11. Assist at breech, and man fall.
12. Assist at breech, and man fall.
13. Hook side-tackle to griolet, and man fall.
14. Man fall.
15. Man fall.
16. Man fall.
17. Man fall.

NOTE.—The 1st part of the gun's crew shift the carriage; the 2nd part lower the gun, if required.

Fire Quarters.

No. at Gun—1. Fire Party.
2. Fire Party.
3. At quarters.
4. Smothering Party.
5. At quarters.
6. Smothering Party.
7. At quarters.
8. At quarters.
9. At quarters
10. At quarters.
11. Lead hose along.
12. Get up buckets and swabs.
13. Man pumps.
14. At quarters.
15. At quarters.
16. Lead hose along.
17. At quarters.

NOTE—The above has reference to the *Fire Bill* as given in the text.

Stations at Gun.

No. at Gun—1. 1st Captain; 2nd Boarder.
2. 2nd Captain; 1st Boarder.
3. 1st Loader; 2nd Boarder.
4. 1st Sponger; 2nd Boarder.
5. 2nd Loader; 1st Boarder.
6. 2nd Sponger; 1st Boarder.
7. 1st Shellman and Pikeman.
8. 2nd Shellman and Pikeman.
9. 1st Handspike and 2nd Boarder, or 2nd Rifleman.
10. 2nd Hand-spike and 1st Boarder, or 1st Rifleman.
11. 1st Train Tackle and Fireman.
12. 2nd Train Tackle and 1st Rifleman.
13. 1st Side Tackle and Pumpman.
14. 2nd Tackle and 2nd Rifleman.
15. 1st Port Tackle and 1st Rifleman.

16. 2nd Port Tackle and Fireman.
17. Powder Boy.

Manner of Working Both Sides.

Equipment of Boats.

The Instructor to call the numbers, and the crew to answer as to their duties in fitting the boat out for "distant service." *Boarders, Riflemen, Pikemen,* &c., to be instructed in their duties; the "calls," &c.

Shifting from Right to Left.

Words of Command, and Duty of each Man at each and every Command.

For example: the Instructor commands: "Serve vent and sponge," and then question each man upon his particular duty at that command.

NOTE—Refer to HARBOR ROUTINE, page 17, *Morning and Evening Quarters.*

SECOND INSTRUCTION.

Sponging and Loading.

QUESTIONS—1. How serve the vent in sponging?
2. How serve the vent in loading?
3. Why is it important to withdraw the wire in time, in case the charge is to be rammed home a second time?
4. Why do you close the vent in sponging?
5. Why do you close the vent in loading?
6. Why do you clear the vent both before and after sponging?
7. *How* do you clear a vent?
8. Show practically the use of the drill and bow.
9. How put a cartridge in a gun?
10. *Why* put the seam sideways, or down?
11. How draw a cartridge?
12. How load with a shell? (Time fuze.)
13. How load with a shell? (Percussion.)

14. What is a *sabot*, and its use?
15. How draw a shot, or shell?
16. How draw a projectile from a rifled gun?
17. How draw a junk wad?
18. How draw a grommet wad?
19. When use a wad?
20. Is it ever used in a rifled gun?
21. When would you "double shot?"
22. Would you double shot a 9-inch gun?
23. Do you ever load with two shell?
24. Suppose in loading with shell the fuse should ignite?
25. What precaution use in taking off the patch?
26. How do you sponge a gun?
27. Why turn the sponge in a particular way?
28. Suppose you "draw fire?"
29. Do you ever *wet* the sponge?
30. If a shot or shell should *jamb* in a gun, would you fire it?
31. How are shell boxes distinguished?
32. What distinguishing marks are put on to indicate 5, 10, and 15-sec. fuzes?
33. What indicates a percussion fuze?
34. Why are rifle shell generally fitted with percussion, instead of time fuzes?
35. For what distance use a 5″ fuze (9-inch gun)?
36. " " " " 10″ " "
37. " " " " 15″ " "
38. " " " " grape "
39. " " " " canister "
40. What colors are used to distinguish the different charges.
41. When do you use a scraper?
42. Where do you go for powder?
43. Where do you go for shot or bolts?
44. Where do you go for shell?
45. Where is the passing-box sent down?
46. What becomes of it then?
47. What is done with empty shell boxes?
48. Where are wounded men carried?
49. Who carry them to the hatches?
50. How load a gun with a hot shot?

51. What is the *charge* of this gun?
52. What is an incendiary shell.
53. How are the boxes containing them distinguished?
54. What is a liquid shell?
55. What is McEvoy's igniter?

THIRD INSTRUCTION.

Pointing.

1. What do you call "line of metal?"
2. Point the gun by line of metal.
3. Would your shot go above or below the mark (within point blank)?
4. How will you point in order that your shot will not go above?
5. What is "dispart?"
6. If the distance is more than the point blank range, how will you point?
7. What is meant by point blank?
8. If your gun has much elevation, will you see the object?
9. Is there any way of giving the gun elevation, and keeping sight of the object at the same time?
10. Show practically the use of the Tangent sight?
11. In pointing, what would be the effect of not keeping your eye close down to the notch?
12. Why is it necessary that you should get your object *on* at the full extent of the lock-laniard?
13. How lay your gun-ship rolling—having given the distance?
14. Suppose the distance is increased or diminished?
15. Suppose, after having pointed, the ship heels to, or from the object?
16. What is tangent firing?
17. How would you "extreme train" forward, or aft?
18. How would you lay your gun level in an open roadstead, or at sea (no motion on)?
19. How do so in harbor?
20. What is the Trunnion sight?

21. How much elevation does this port admit of?
22. How much depression?
23. What limits the depression of the bow and stern guns of the iron-clads?
24. Would you train or elevate first?
25. What is one complete turn of the screw of the 9-inch gun equal to?
26. What use can be made of this?
27. What is a gunner's quadrant, and its use?
28. What part of an iron-clad would you aim at?
29. What projectile use?
30. What position take in engaging a Monitor?

FOURTH INSTRUCTION.

Firing.

1. Your gun having been pointed, when do you fire (ship rolling)?
2. Suppose you miss fire?
3. Suppose the wafer explodes, and the priming burns out —how proceed?
4. Where do you stand in firing?
5. What is the "drill" in quick firing, and where the noise is so great that the *commands* cannot be heard? Give a practical illustration?
6. Suppose your lock is blown off?
7. How do you put in a spur tube?
8 How apply a match?
9 What is "direct firing?"
10. What is "ricochet firing?"
11. When adopt the one or the other?
12. If, firing with a full charge, you change to a reduced charge, will the same elevation answer?
13. Why will the range be increased after firing a number of rounds?
14. What will be the effect on the recoil?

FIFTH INSTRUCTION.

Miscellaneous.

1. On what does the time of bursting of a loaded shell depend?
2. What are the bursting charges of the different shells used?
3. What are shrapnel, or spherical case shells?
4. What is a Spur Tube?
5. How do you put in a primer?
6. Name the charges for the different kinds of Navy guns.
7. What is the weight of the different projectiles used in the various kinds of Navy guns?
8. How calculate the weight of a spherical cast-iron shot, or shell?
9. Picked up a spherical cast-iron ball, weighing 98 pounds; required the diameter of the bore of the gun?
10. How spike or unspike a gun?
11. How burst a gun?
12. What is the axis of a piece?
13. How secure a gun for sea?
14. How house a lower deck gun?
15. Why is it done?
16. How throw a gun overboard?
17. How hoist a gun in?
18. Suppose a shot gets adrift in a gun in a gale of wind?
19. In a gale a gun gets adrift?
20. What is a Tennessee Saucer?
21. What other "cups" or "saucers" are used?
22. Give the nomenclature of the gun and carriage.
23. What are the duties of a Division Officer?
24. Describe the battery of the ship in which you last served; the drill; the guns; the carriages; charges; projectiles; fuzes, &c.
25. Make out a Watch and Quarter Bill for an iron-clad of 4 guns?
26. Describe any breech-loading cannon you may have seen.
27. Describe any breech-loading rifle you may have seen.

28. What object was sought to be obtained by loading at the breech?

29. What is the principle of the Minie rifle?

30. Describe the Carabine à Tige.

31. What are the objections to breech-loading cannon and small arms?

32. What are the advantages of?

33. Why is a rifled gun superior to a smooth-bore in range and accuracy?

34. What is the "parabolic theory?"

35. How does the resistance of the air affect spherical shot?

36. If a shot is *eccentric*, towards what direction will it deviate?

37. What is a Ballistic Pendulum?

38. What is the *initial* velocity of a shot?

39. How is the velocity of recoil calculated?

40. How is a gun "disparted?"

41. How are the divisions on the sight-bars calculated?

42. What is a Columbiad?

43. Describe the manner of casting, boring and rifling guns.

44. What are the proportional charges of guns—smooth bore and rifled?

45. Describe the different fuzes in use?

46. What windage is allowed in our smooth bore and rifle guns.

47. On what does the initial velocity of a projectile depend?

48. Strap a shell.

49. How is gunpowder manufactured?

APPENDIX.

DIMENSIONS AND DESCRIPTION OF THE U. S. FRIGATE MERRIMACK.

Length over all,	300	feet.	
" from knight heads to taffrail,	281	"	
" from forward side of rabbit of stern to forward side of propeller hole at water line, and 23 feet draft,	257	"	9 inches.
" of keel,	247	"	
Breadth—extreme,	51	"	4 "
" moulded,	50	"	2 "
" extreme at spar deck,	46	"	
Depth of hold to spar deck,	33	"	8 "
" " to gun deck,	26	"	3 "
Height between berth and gun deck in clear of beams,	5	"	9 "
" between gun and spar deck in clear of beams,	6	"	
Depth of keel—forward,	1	"	9 "
" " aft,	2	"	3 "
Keel is sided,	1	"	6½ "
Deep load draft,	23	"	
Area of immersed midship cross section at deep load, including keel,	876	square feet.	
Length amidships devoted to engines and boilers,	60	feet.	

Number of tons of coal stowed below berth deck, 575.

The frame is of live oak, sided 13 inches, and moulded 17 inches at the floor and 14 at the sides. The frame is filled in and caulked 14 feet out from the keelson. The keel, stem and stern post are framed into the ship 10 inches.

The frame is cross strapped on the inside by iron bands 4½

by ¾ inches, running from the spar deck clamps down to the turn of the bilge, at an angle of 45 degrees with the keel, and at right angles to each other. These are bolted into each timber, and each crossing with 1¼ inch bolts. She is also strapped on the outside from the stem and stern post. The breadth of stern post in the wake of the shaft is 29 inches, and at that point the depth of the dead wood through which the shaft passes is 20 feet.

The after dead wood is strengthened by copper bolts, the length of which are from 14 to 17 feet, running diagonally down to the keel, and from 1¼ to 1½ inches diameter.

Forward she has ten live oak breast hooks, and aft she has seven breast hooks that side 10 inches. The after cants are fitted together as high as the berth deck, and bolted edgewise. The garboard straiks are 10 inches thick, and bolted through and through from side to side, making the seats of the floor 4 feet in length. The plank upon the bottom is of white oak, 5 inches thick. The wales are 7 inches thick.

The orlop decks extend from the engine room bulkheads forward and aft. They are kneed with simple lodge knees. The berth deck beams are of yellow pine, and side 16 inches. They are kneed with one dagger and one lodge, siding 8 inches, and in the wake of the masts with two lodges and one dagger.

This deck has seven straiks of clamps, each 12 inches wide and 7 thick, keyed together with locust keys.

The gun deck beams are of hard pine, sided 17 inches and moulded 14. They are supported by two lodge and one hanging knee, at one beam, and by two lodge knees at the next. The hanging knees side 10 inches. Clumps of white oak 7 inches thick fill the space between the berth and gun deck. On each side the hatches on this deck are seven straiks of hard pine plank 6 inches thick, set into the beams and dowelled together, and next to the water way there are 5 straiks 8 inches thick bolted through and through from side to side with 1¼ inch bolts; the rest of the planking on this deck is 5 inches thick. This deck is *pierced* for 38 guns; the post sills are 20 inches deep.

The overhanging stern is supported from this deck by 2¼ inch wrought iron bolts running to spar deck beams at an angle of 50 degrees with the keel; also by bolts running hori-

zontally from the outside of the ship through the spar deck beams. The spar deck beams are sided 17 inches and moulded 13. They are supported by two lodge knees at one beam, and one hanging knee at the next.

The planking of this deck is 4 inches thick. The underside of rail is 3 feet 8 inches above the deck. The bulwarks are *pierced* for 28 guns, besides the long ports at bow and stern for the pivot guns.

The top of the hammock rail is 5 feet 8 inches above the deck, and the top of the hammocks, when stowed, 7 feet 8 inches. The forward side of the propeller hole is formed of solid live oak bolted through and through.

The propeller hole is 7 feet fore and aft, and 8 feet athwart ships. The ship is fastened entirely with copper bolts below, one foot above deep load line, and above that with iron.

There has been driven into her hull 226,740 lbs. of iron, and 139,778 lbs. of copper bolts of 1½, 1¼, ½ and ¾ inches diameter.

Her spar deck is flush fore and aft.

On the gun deck is the Captain's cabin, which occupies 30 feet in length of the after part of the deck. There are no guns in it. The ship's galley is on the forward part of this deck. And just forward the smoke-pipe are the hoisting engines, the reels being immediately above them on the spar deck.

On the berth deck, commencing aft, is the ward room; it occupies 45 feet in length of this deck; it has 16 state rooms, besides that of the Chief Engineer, the body of which is forward of the bulk-head, through which it opens into the ward room. Forward of the ward room bulk-head, on the starboard side, is the Midshipmens', and on the port side the Assistant Engineer's steerages. Amidships is first a hatch, and next a mess room for the Assistant Engineers; next a hatch, and then the Forward officers. Then a hatch, pumps, engine room hatch, smoke-pipe and boiler hatches. At the sides forward the steerages, store rooms, dispensary, Forward officers' state rooms and coal bunkers. All bulk-heads on this deck are panneled and grained out and maple.

The forward part of the deck is bulk-headed off for a sick bay. On the after orlop are the cock-pit, two large bread rooms, two sail rooms, two store rooms, and two fine large

state rooms, for the use of the Captain's and Purser's clerks respectively. The forward orlop has the general store room, two sail rooms, and two bread rooms.

Model.

Of her entering water lines, the first one above the keel is very concave, but the concavity gradually decreases as you rise, until the deep load line is straight. The angle of divergence at this point is 57 degrees. Above this the lines grow more and more convex, until at the spar deck, she presents a full bow, giving ample room to work her great pivot gun.

The after body is much finer than the fore body, and here also the water lines are concave below the deep load line, giving a fine clear run, which will enable her screw to work in good solid water even at high rates of speed. Her dead rise is 19 degrees or 37 inches at half floor; the floor being 18 feet. She gets her full beam at two feet below the deep load line, and retains it for two feet above; thence tumbling gradually 2 feet 3 inches to the spar deck, from whence the bulwarks gradually assumes the perpendicular. In her cross section the floor is the only portion that presents a perfectly straight line.

She has a round overhanging stern, with quarter galleries; forward she is ornamented with a simple scroll billet-head under the bowsprit.

She has but little sheer, just enough, in fact, to give her the necessary lightness of appearance, which creates the impression of buoyancy and speed, without taking from her that heaviness which gives the idea of great strength and power, always considered so necessary in the *tout ensemble* of a man-of-war.

Armament.

On the gun deck she carries 24 nine inch shell guns, each weighing 92 cwt. independent of carriage. On the spar deck she carries two pivot guns of 10 inch calibre, each weighing

112 cwt., and 14 broadside guns of eight inch calibre, weighing 63 cwt. each. These guns are all calculated to throw hollow shot and shells. No solid shot will be carried in the ship.

Spars.

Mainmast. Height from spar deck to trestle-trees 86 feet 9 inches; from trestle-trees to cap 19 feet 8 inches.

Diameter at partners, 42 inches.

Topmast, 68 feet to cross-trees; mast-head 10 feet 10 inches. Diameter at lower-mast cap 21 inches.

Top-gallant mast, 34 feet. Diameter 12½ inches.

Royal mast, 23 feet; pole 10 feet 5 inches—making the main truck 222 feet 2 inches.

Length of main yard, 110 feet 4 inches; length of arm, 4 feet 6 inches. Diameter at sling, 55¾ inches.

Top-sail yard, 83 feet 4 inches; arm, 7 feet 4 inches. Diameter, 20½ inches.

Top-gallant yard, 52 feet 3 inches; arm, 2 feet 9 inches. Diameter, 10¼ inches.

Royal yard, 35 feet; arm, 1 foot 9 inches. Diameter, 7 inches.

Foremast. Spar deck to trestle-trees, 78 feet 9 inches; trestle-trees to cap, 18 feet 2 inches. Diameter at partners, 38 inches.

Topmast, 62 feet 6 inches to cross-trees; mast-head, 10 feet. Diameter at lower mast cap, 21 inches.

Top-gallant mast, 31 feet 3 inches. Diameter, 12¼ inches.

Royal mast, 21 feet 3 inches; pole 5 feet—making the fore mast 198 feet 9 inches.

Fore yard, 99 feet 4 inches; arm, 4 feet 2 inches. Diameter, 23½ inches.

Top-sail yard, 75 feet; arm, 6 feet 9 inches. Diameter, 18¾ inches.

Top-gallant yard, 47 feet; arm, 2 feet 7 inches. Diameter, 9⅜ inches.

Royal yard, 31 feet 6 inches; arm, 1 foot 8 inches. Diameter, 6¼ inches.

Mizen mast. Spar deck to trestle-trees, 72 feet 5 inches; trestle-trees to cap, 8 feet 3 inches. Diameter at partners, 28 inches.

Topmast, 51 feet to cross-trees; mast-head, 8 feet 3 inches. Diameter at lower mast cap, 15 inches.

Top-gallant mast, 25 feet 6 inches. Diameter, 9 inches.

Royal mast, 17 feet 4 inches; pole 4 feet—making the mizzen truck 170 feet 6 inches above spar deck.

Cross-jack yard, 81 feet; arm, 3 feet 6 inches. Diameter, 17¾ inches.

Top-sail yard, 61 feet; arm, 5 feet 6 inches. Diameter, 15 inches.

Top-gallant yard, 28 feet 2 inches; arm, 2 feet 1 inch. Diameter, 7½ inches.

Royal yard, 25 feet 6 inches; arm, 1 foot 4 inches. Diameter, 5 inches.

Spanker boom, 58 feet; pole, 2 feet. Diameter, 13 inches.

Gaff, 41 feet: pole, 5 feet; diameter, 8½ inches.

Bowsprit. Outboard, 36 feet. Diameter, 38 inches.

Jib-boom, 27 feet. Diameter, 17 inches.

Flying jib-boom, 20 feet 3 inches; pole, 3 feet. Diameter, 10½ inches.

The foremast steps in a solid mass of live oak on the fore hold.

The main mast comes just immediately abaft the engines, and consequently, immediately over the shaft; it is, therefore, stepped upon a live oak beam 3 feet wide and 15 inches deep, kneed at each side of the ship with two horizontal and one hanging knee, and supported by two solid wrought-iron columns 10 inches in diameter, one on each side of the shaft.

The mizzen mast is stepped as usual upon the after orlop.

Sails.

One complete suit of the ship's sails will cover an area of 58,372 square feet, divided as follows:

Fore sail, 4,026 square feet, main sail, 5,125 square feet, spanker, 2,185 square feet.

Fore top sail, 3,692 sq. ft., main top sail, 4,560 sq. ft., mizzen top sail, 2,436 sq. ft.
Fore top-gallant, 1,488 sq. ft., main top-gallant, 1,815 sq. ft., mizzen top-gallant, 975 sq. ft.
Fore royal, 693 sq. ft., main royal, 815 sq. ft., mizzen royal, 459 sq. ft.
Lower studding sails, 2,856 sq. ft., each.
Fore top mast " 1,970, main top mast studding sails, 2,190 square feet.
Fore top gallant sails, 924 sq. ft., main top-gallant, 918 sq. ft.
Jib, 2,425 sq. ft., fore spencer, 2,193 sq. ft.
Flying jib, 1,780 sq. ft., main spencer, 2, 166 sq. ft.
All storm sails, 3,785 sq. ft.

CORRECTIONS AND ADDITIONS

TO

HARBOR ROUTINE.

Bottom of page 8, insert: "The *chain keepers* should now put the chains in order."

Page 11, after 9th *question*, insert: "*Answer*—A Flag Officer answers *Flag;* a Captain, the *name of his ship;* Ward Room Officers, *Aye, Aye;* Steerage Officers, *No, No;* a Sailor, *Halloo.*"

Page 16, third line from top: for "pail," read "*rail.*"

Page 23, third line from bottom: for "pratigue," read "*pratique.*"

Page 26, third line from top: for day, read *dry.*

Page 26, twelfth line from top: for tout, read *taut.*

Page 26, twentieth line from top: omit, "except the square yardmen.

Page 26th, after 8th question, insert: "*Answer*—The fore and mizen top-gallant yards and the main royal yard on the port side; the main top-gallant and the fore and mizen royal yards on the starboard side. This only applies to port—the object being to give more room at the yard-ropes.

Page 27, 15th line from bottom: for aoon, read *soon.*

Page 27, 14th line from bottom: for stradied, read *steadied.*

Page 28, after Article "to cross top-gallant and royal yards," insert: "NOTE.—The preparatory signal should be made, but it is not necessary to send men aloft a half hour before the time to overhaul lifts and braces. The top-gallant yardmen can do so when sent up at 8."

Page 30, 15th line from top: for part, read *port.*

Page 30, 21st line from top: for wove, read *rove.*

Page 31, 12th line from top: for barkstays, read backstays.

Page 33, after the Article "to mend sails," add: "NOTE.—It is not *usual* to let fall the sails in mending, but only to skin the sail up afresh, and square the gaskets."

Page 34, 16th line from top: for when, read *where*.

Page 35, after the Article "Bending and Unbending Sails," add: "NOTE.—If a stay whip is used in bending the courses, they can be run up with the topsails, and then all hauled out together; the men laying aloft as the sails are swayed up."

Page 37, after third question, insert: "What is *passing* an oar?"

Page 39, after fourth question, insert: "See Navy Regulations, page 33." After 9th question, insert: "*Ceremonies to be observed at the Gang-way:*

The ceremonies to be observed at the gang-way on officers leaving or coming on board, shall be regulated by the assignment of quarters, as cabin officers, ward-room officers, and steerage or forward officers, as follows:

A commander-in-chief of a squadron shall be attended by the boatswain and eight side-boys.

A commander of a squadron, not commanding-in-chief, by the boatswain and six side-boys.

Other cabin officers, by the boatswain and four side-boys.

Ward-room officers, by a boatswain's mate and two side-boys.

Steerage and forward officers, by two side-boys.

A Commander, when doing duty as Executive Officer, if messing in the ward room, shall be considered as a ward-room officer.

The sentinel at the gang-way will present arms to cabin officers, and carry arms to ward-room officers.

Officers who may be invited to mess in the cabin, will not, on that account, receive any higher honors or ceremonies than those accorded to officers of their proper apartments.

In going into or leaving boats on duty, the Executive Officer will always have the precedence, and other officers will go according to precedence."

Page 39, 27th line from top: for hall, read *haul*.

Page 39, after Article, "Military Honors and Ceremonies,"

add: "NOTE.—In manning the yards, the men can be ordered to *lay out* when the person saluted is "piped out," if thought best.

Page 44, 4th line from top: for lerch, read *leach.*

Page 45, after Article on Tacking, add: "NOTE.—Some ships are provided with *twiddling lines* with which to secure the wheel amidships when going astern."

Page 45, 2nd line from bottom: for fall, read *full.*

Page 49, 9th line from top: before "quarter," insert *other.*

Page 49, 22nd line from top: for why, read *west.*

Page 49, 17th line from bottom: omit *weather.*

Page 50, 7th line from top: for front, read *port.*

Page 51, 7th line from top: for studded, read *studding.*

Page 51, 14th line from bottom: put *comma* after hooked, omit "to," and *comma* after guys.

Page 52, 11th line from bottom; after sail, insert *tack.*

Page 52, after last Article, add: "NOTE.—The inner halliards should be well pulled up *before* walking away with the outer ones."

Page 53, 11th line from bottom: before studding, insert *lower.*

Page 55, after Article 11, add: "NOTE.—The lee clew of the main-sail and the spanker are generally set as soon as it becomes necessary to take in the lee studding sails."

Page 60, 18th line from top: for man the sheet halliards, read man the *sheets and* halliards.

Page 63, 5th line from top: for spackles, read *shackles.*

Page 63, 15th line from top: for tunic, read *time.*

Page 64, 15th line from bottom: for ship, read *slip.*

Page 64, 8th line from bottom; for present, read *prevent.*

Page 64, 5th line from bottom: put a *comma* after engineer.

Page 67, 26th line from bottom: for loose, read *lose.*

Page 67, 24th line from bottom: for saluting, read *salutary.*

Page 67, 18th line from bottom: for making, read *marking.*

Page 68, 11th line from bottom; after "wind up," insert "*the Chronometers.*"

Page 69, 2nd line from bottom: for compare, read *compute.*

Page 71, 5th line from bottom: for as, read *also.*

Page 75, 19th line from top: for space, read *spare.*

Page 76, 18th line from bottom: for interesting, read *intersecting.*

Page 80, 4th line from bottom; for 45, read 84.

Page 81, 18th line from top: for effected, read *affected.*

Page 81, 6th line from bottom: for deviation, read *direction.*

Page 84, 4th line from top: for $\pm$, read $\mp$.

Page 87, 16th line from top: for magnates, read *magnets.*