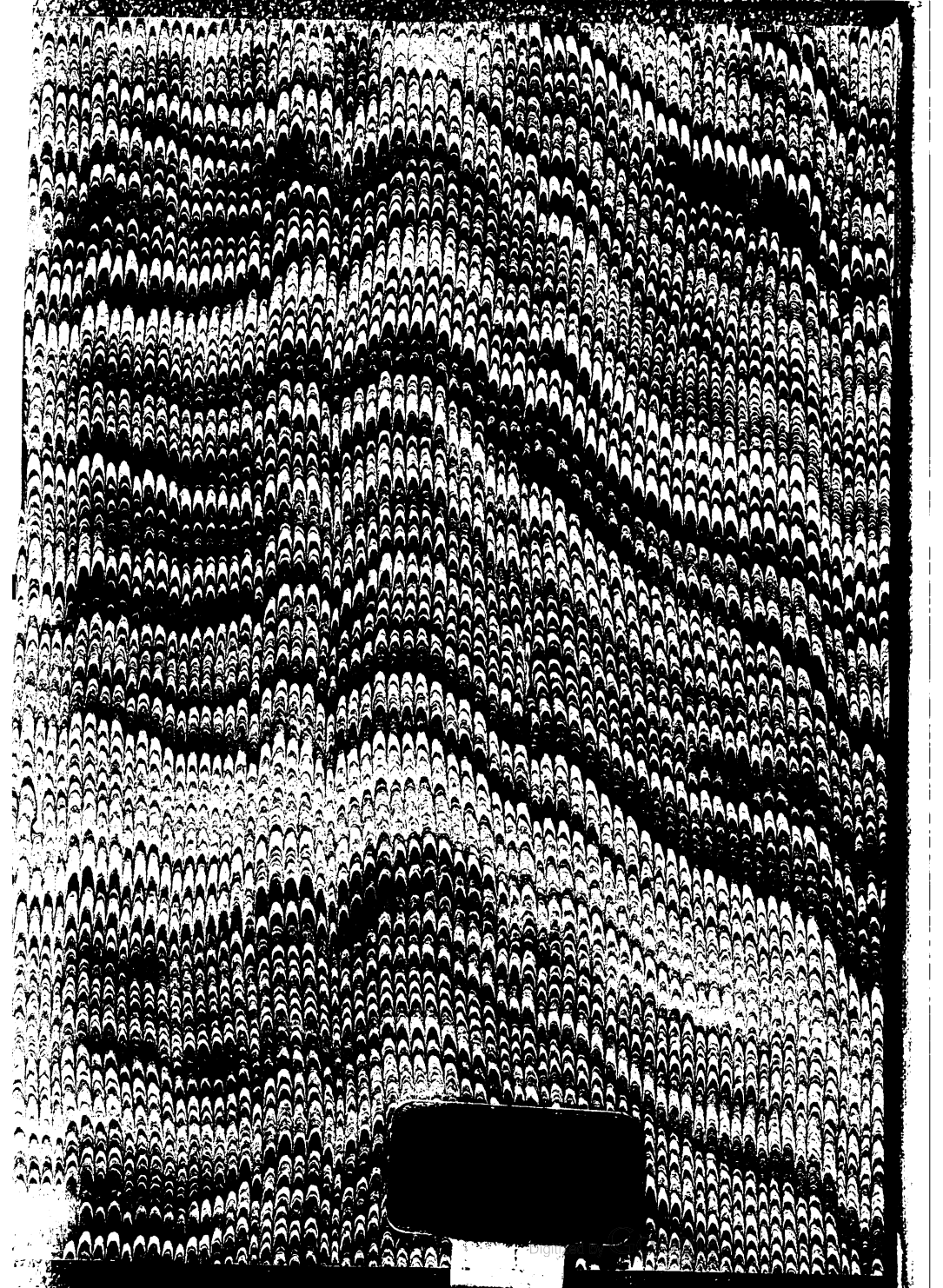
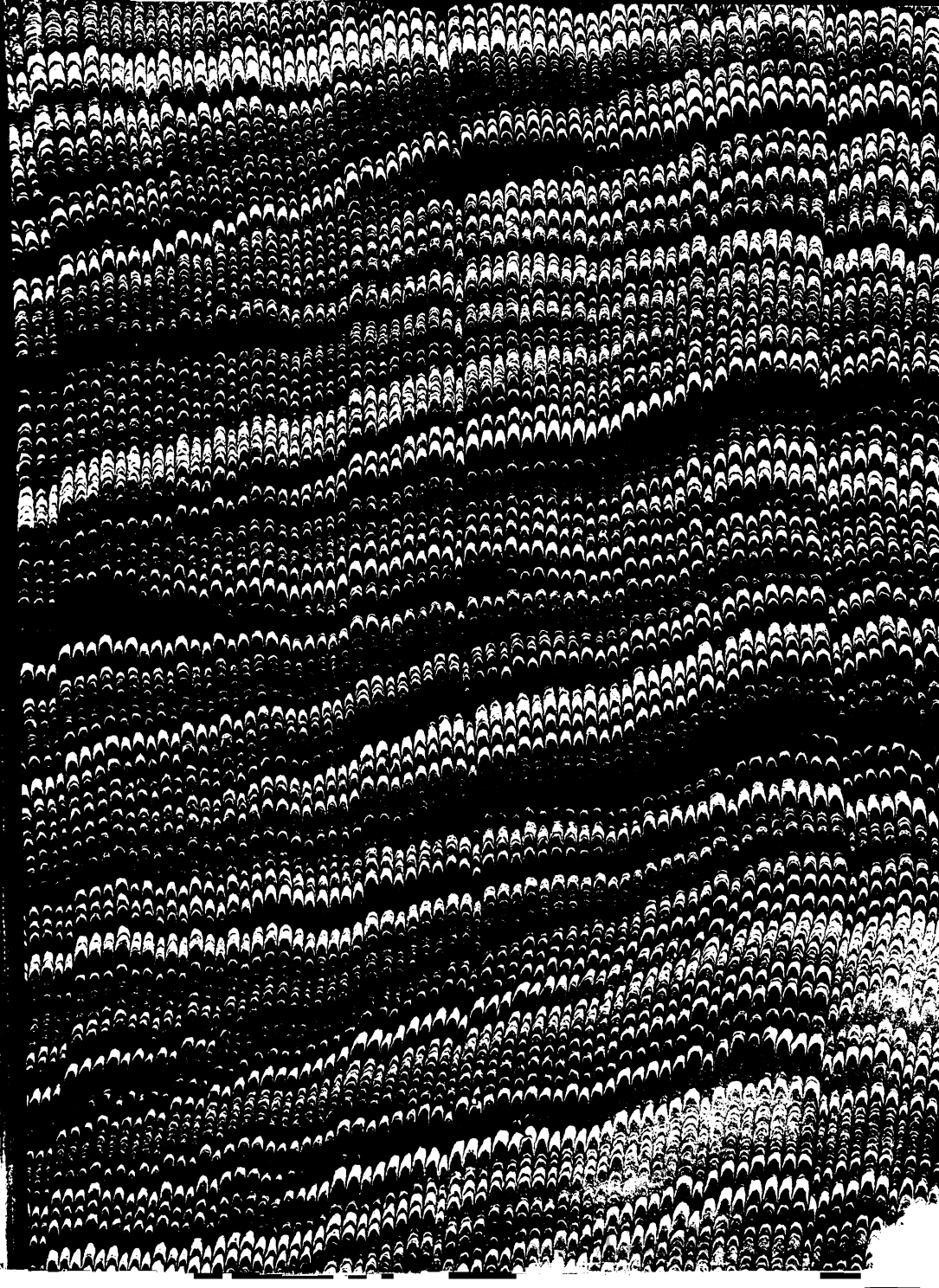




MARINE ARCHITECTURE:

OR, THE

Ship-Builder's Assistant:

CONTAINING

DIRECTIONS

FOR

Carrying on a SHIP, from the first laying of the Keel, to her actual going to SEA.

SHEWING,

I. The Proportions used by Experienced SHIP-WRIGHTS in Building, both *Geometrically* and *Arithmetically* performed. Also the Making, Marking, and Ordering a Bend of Moulds: With a large Table of the SQUARE ROOT, and Directions concerning the Measuring of SHIPS.

II. Directions for MASTING and YARDING of any SHIP, or making both in a just Proportion to the SHIP, and to one another; both as to Length and Thickness. With TABLES of the Weights and Sizes of Anchors and Cables, according to a new Establishment.

III. The BOATSWAIN'S Art; or an Essay upon RIGGING: Shewing how to RIGG a SHIP, or to know the Length and Thickness of every Rope exactly; with CABLE and CORDAGE TABLES, to know, by Inspection, the Weight of any Rope, whose Length and Thickness is given, and the Construction or Making of the said Tables; with some Directions for cutting out SAILS.

The whole Illustrated with SCHEMES and DRAUGHTS, to render it intelligible to All Capacities.

LONDON:
Printed for WILLIAM and JOHN MOUNT, and THOMAS PAGE, on *Tower-Hill*. M.DCC.XLVIII.

PREFACE.

THE Advantages arising from SHIPPING *are so eminent and conspicuous, especially to the Inhabitants of this Island, that Arguments are unnecessary in favour of the* ART OF SHIP-BUILDING, *or* MARINE ARCHITECTURE; *an Art so superlatively Useful, that whatever tends to the Advancement thereof, deserves Encouragement; and whatever Improvements are made therein, adds so much to the Security, Strength, and Interest of the Nation.*

The following Sheets were formerly compiled for this Purpose, being intended for the Instruction of Those *desirous to be acquainted with these surprizing* Fabrics; *and as they have been so kindly received, we doubt not but this Edition will meet with usual Acceptance at least, as it is improved in the Masting, Yarding, and Rigging; and that it will be of some Service to* Ship-Carpenters, Boatswains, *&c. as well as to the young* Mariner, *for whose Use and Benefit it is chiefly intended.*

THE

THE

CONTENTS.

THE

THE

Compleat SHIPWRIGHT.

CHAP. I.

Of Geometrical PROBLEMS.

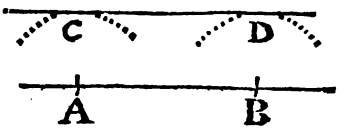
BEfore we proceed to draw the Draught of any Ship or Veſſel, it will be neceſſary to be acquainted with ſome Terms in *Geometry:* As, to know what a Point and a Line meaneth, which every Book treating of *Geometry* plainly teacheth, and therefore we ſhall paſs that by, ſuppoſing that none will endeavour to ſtudy the Art of a SHIPWRIGHT, that is ignorant of theſe Things. And therefore, leaving theſe Definitions, I will proceed to ſome Geometrical PROBLEMS neceſſary to this Art.

PROBLEM I.

How to draw a Parallel Line.

Parallel Lines are ſuch as are equidiſtant one from another in all Parts, and are thus drawn: Draw a Line of what Length you pleaſe,

(according to your Occaſion) as the Line *A B*, then open the Compaſſes to what Diſtance you pleaſe, or as your Occaſions require, and ſet one Foot of the Compaſſes towards one End of the given Line, as at *A*, with the other Foot make a Piece of an Arch of a Circle, over or under the given Line, as the Arch *C*; keeping the Compaſſes then at the ſame Diſtance, make ſuch another Arch towards the other End of the Line, ſetting one Foot in *B*, and with the other deſcribe the Arch *D*, then laying a Ruler to the Outſide of theſe two Arches, ſo that it may exactly touch them, draw the Line *C D*, which will be parallel to the given Line *A B*, or equidiſtant; for ſo ſignifieth the Word *Parallel*, to be of equal Diſtance.

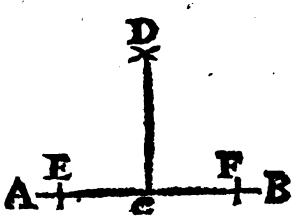


PROB. II.

How to erect a Perpendicular, from a Point in a right Line given.

Let there be a Point given in the Line *A B*, as the Point *C*, whereon to raiſe a Perpendicular.

Set one Foot of the Compaſſes in the given Point *C*, and open them to what Diſtance you pleaſe, as to the Point *E*; make a little Mark at *E*, and keeping the Compaſſes at the ſame Diſtance, turn them about, and make a Mark at the Point *F*, in the Line *A B*: Then remove the Compaſſes to one of thoſe Marks at *E*, or *F*, and ſetting one Foot faſt therein, as at the Point *F*, open the other Foot wider, and therewith draw a ſmall Arch over the Point *C*; as the Arch *D*: then keeping the Compaſſes at the ſame Diſtance, remove them to *E*, and ſetting one Foot in *E*, with the other Foot draw another little Arch, ſo as to croſs the former Arch in the Point *D*; through the croſſing of theſe two Arches *P D*, draw a Line to the given Point *C*, as the Line *D C*, which will be perpendicular to the Line *A B*.

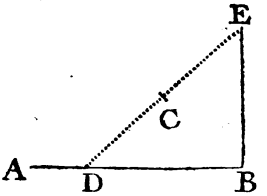


PROB.

PROB. III.

To raiſe a Perpendicular at the End of a Line.

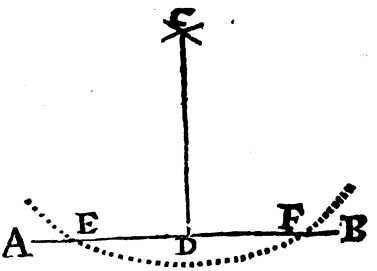
Draw a Line at pleaſure, or according to your Work, as the Line *A B*; on the End thereof, as at *B*, ſet one Foot of the Compaſſes, and open them to what Wideneſs you pleaſe, as to *C*; then keeping one Foot of the Compaſſes in *C*, and at the ſame Diſtance, remove the Foot that was in *B*, to the Point *D*, in the Line *A B*: Then (keeping the Compaſſes ſtill at the ſame Diſtance) lay a Ruler to the Points *D* and *C*, and with your Compaſſes ſet off the Diſtance from *C* to *E*. Laſtly, draw the Line *E B*, which will be perpendicular or ſquare to the End of the given Line *A B*.



PROB. IV.

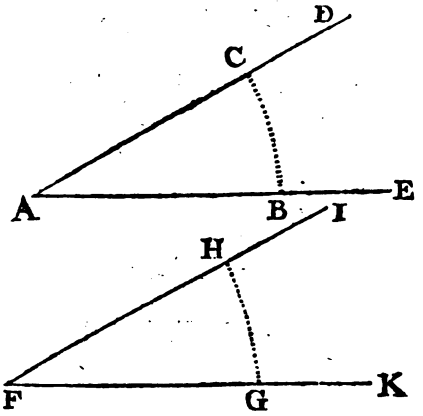
From a Point given, to let fall a Perpendicular upon a Line given.

From the Point *C*, let it be required to let fall a Perpendicular upon the Line *A B*. Proceed thus: Fix one Foot of the Compaſſes in the Point *C*, and open them to a greater Diſtance than juſt to the Line *A B*, and make with the ſame Extent the two Marks *E* and *F*, in the given Line *A B*, then divide the Diſtance between the two Points *E* and *F*, into two equal Parts in the Point *D*; then lay a Ruler to the given Point *C*, and to the Point *D*, and draw the Line *C D*, which will be Perpendicular to the given Line *A B*.



PROB. V.

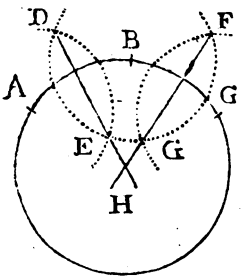
To make an Angle equal to any given Angle.



Let *D A E* be an Angle given, and it is required to make another Angle equal thereto: To do this, Firſt draw the Line *F K*, then with any convenient Diſtance leſs than *A E*, deſcribe the Arch *C B*; then placing the Compaſſes at *F*, with the ſame Diſtance which ſwept the Arch *C B*, ſweep the Arch *H G*; take the Arch *C B* in the Compaſſes, and ſetting one Foot in the Point *G*, croſs the Arch *G H* in the Point *H*, then through the Point *H* draw the Line *F H I*, and it is done; for then the Angle *I F K* is equal to the Angle *D A E*, as was required.

PROB. VI.

To bring any three Points, not ſituate in a right Line, into the Circumference of a Circle.

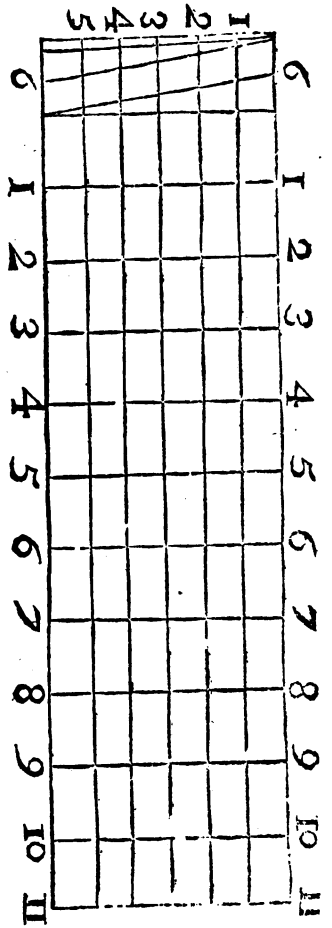


Let the three Points through which the Circle is to paſs be *A B C:* Take above half the Diſtance between the two Points *A* and *B* in the Compaſſes, and with one Foot fixed in the Point *A*, deſcribe the Arch *D E*; then with the ſame Diſtance, and one Foot fixed in the Point *B*, croſs the former Arch in *D* and *E*, and draw the Right Line *E D:* Then with the ſame Diſtance in the Compaſſes, and one Foot in *C*, deſcribe the Arch *F G*, and with that ſame Diſtance, and one Foot in *B*, croſs the ſaid Arch in *F* and *G*, and draw the right Line *F G:* Now where the two right Lines *D E* and *F G*, being continued, interſect each other (as in the Point *H*) is the Centre of the Circle required.

CHAP.

CHAP. II.
Of your SCALE.

BEING perfect in the raising and letting fall of Perpendiculars, and in the drawing of Parallel Lines, you may proceed to Draught: But first I will explain to you the Use of a Diagonal Scale of Inches and Feet, whose Use is to represent a Foot Measure, or a Rule so small, that a Ship of 100 Foot by the Keel, may be demonstrated on a common Sheet of Paper, to be so many Feet long, and so many Feet broad, of such a Depth and of such a Height between the Decks. And therein, the first Thing to be considered is the Length of the Platform, and of the Vessel you intend to demonstrate, to the End you may make your Scale as large as you can; because the larger your Scale is, the larger will your Draught be, and so the Measure of the Demonstration will be the larger, and more easy to unfold. The Scale adjoining consisteth (as you see) of 12 Feet in all, 11 thereof are marked with Figures downwards, beginning at 1, 2, 3, 4, and so to 11. The first at the Top is subdivided into Inches by Diagonal Lines, as the Distance between the first Line of the Scale, and the first Diagonal Line is one Inch, the second is two, and the third three Inches, and so to six. The way to demonstrate the Scale, you see, is very easy. Draw seven Lines parallel to each other, and of what Length you please, to retain what Number of Feet you please; then begin at the Top, set off with the Compasses the Length of your Feet both below and above; then draw Lines thwart the Parallel Lines to every Foot of the Scale, and set Numbers to them, (beginning at the second Foot 1, and to the third 2, to the fourth 3, and so forward) leaving the first Foot to be divided into Inches by the Diagonal Lines; as you see in the Scale annexed.



CHAP.

CHAP. III.

Concerning the drawing your Draught upon Paper.

HAving fitted your Scale ready, draw a Line to repreſent the Keel of the Ship, which we will ſuppoſe to be of 60 Feet long by the Keel, and 20 Feet broad: Then draw a Line underneath of equal Length, to repreſent the Bottom of the Keel. Then next you may proceed to the Stern-poſt, drawing a Line repreſenting the foreſide or the inſide thereof, raking the one Quarter of his Length aft, and for the Length of the Stern-poſt, it muſt be directed to the Built of the Ship; as whether ſhe be to be a deep Ship, or a ſhallow Ship, ſo that the Draught of the Water ought to be reſpected firſt, and then the lying of the Ports for the Convenience of Ordnance, for that the upper Tranſom of the Buttock, commonly is juſt under the Gun-room Ports, to the upper Edge of the ſaid Tranſom, we underſtand the Length of the Stern-poſt; altho' if the Stern-poſt were continued to the Height of the Tiller, and another Tranſom fay'd there for the Tiller to run on, it would ſteady the Quarters of the Veſſel very much, and do good Service.

The Rake of the Stem is now allowed to be three Fourths of the Breadth of the Ship, which in this Ship of twenty Feet broad, is fifteen Feet, which is enough, for too much Rake with the Stem doth a great deal of Damage to any Ship, if we conſider that in this ſmall Veſſel, had we given 5 Feet more Rake, all the Weight of the Ship's Head and Bolt-ſprit, Foremaſt, Manger, Hawſes, and Breaſt-hooks aloft, had been ſo much farther forward, where there would have been want of Body to ſupport it, ſo that it muſt of Neceſſity be a Detriment to the Veſſel when ſhe ſaileth againſt a Head-Sea, and a great Strain to her. Now it will be very good to ſpend as much of this Rake as we can under the Water; for it will help the Ship to keep a good Wind, by giving her ſomething more Body in the Water.

Next draw the Water-line, which in this Draught may be drawn to 9 Feet height afore, and to 10 Feet height abaft from the upper Edge of the Keel, and higher abaft than afore, for moſt Ships ſail by the Stern, and alſo for that the Guns ſhould lie ſomething higher abaft than afore from the Water.

Then

Then proceed to hanging of the Wails, and here you ſee the lower Wail drawn from the Head of the Stern-poſt, to ſignify that it ſhould lie againſt the End of the Tranſom, that the Tranſom Knees might be bolted to the Wails without board to one Foot and an half under the Water-line, a little below the middle of the Water-line, and at 9 Foot high on the Stem, and the next Wail parallel to the lower Wail, one Foot and an half aſunder, ſo that the upper Wail will lie juſt at the Water's edge, in the Mid-ſhips; the upper edge of the Gun-deck will lie one Foot above the Water-line abaft, and a half Foot above Water on the Stem; ſo then letting the lower Sell of the Ports be two Feet from the Gun-decks, the lower Edge of the Ports will be three Feet from the Water abaft, and two Foot and a half afore, in the middle of the Gun-deck 2 Foot 9 Inches, ſufficient for ſo ſmall a Veſſel; a greater Veſſel would require to have the Guns ſomething farther from the Water: Then if another Wail be required, firſt ſet off the Ports in their Places, that the Wail may lie above the Ports, or elſe he would be cut with the Ports in pieces, the upper Deck with height reſpecting the Bigneſs of the Ship, having reſpect to not over-building ſmall Ships, to damage their bearing of Sail.

Then for the Head, the length of the Knee would be two thirds of the breadth, ſo then the Knee of the Head in this Draught will be 12 Feet 8 Inches long, and for this place, as low as conveniently he can, provided that the Rails of the Head come not foul of the Hawſe-holes, becauſe that in placing of the Knee low, giveth room to round the Head, and ſteeve it to Content. The Place of the Knee will be at, or very near, the upper Wail, the upper edge of the Knee againſt the upper edge of the upper Harping, which will be very well for the lower Cheeks of the Head to be fayed againſt; for by that means they will be clear of any Seam to avoid Leakings, and will very well bolt the End of the Harping; if a Breaſt-hook be faſtened alſo within board againſt them, it will very well faſten all together.

Then for the ſteeving of him, and rounding the Knee, a Regard muſt be had to the lying of the Bolt-ſprit, leaving room enough for the Lion and Scrowl under the Bolt-ſprit. Then for the rounding of the Rails, round them moſt at the After-ends.

For the heights between Decks and Steerage, Cabin and Fore-caſtle, thoſe Heights are commonly mentioned in Contract by the Maſter or Owners building.

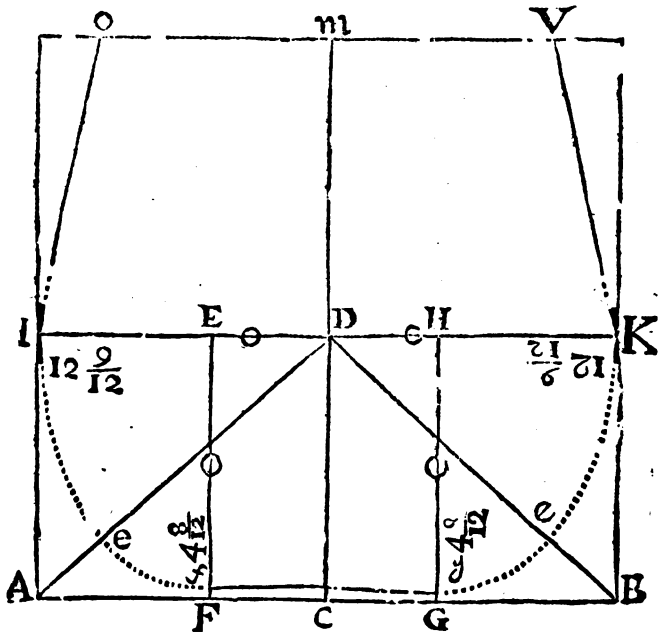
CHAP.

CHAP. IV.

How to sweep out the Bend of Moulds upon a Flat, for a Ship of twenty Feet broad. See the following Figure.

FIRST draw a Line, as the Line *AB*; then in the middle thereof, as at the Point *C*, raise a Perpendicular, as in the Line *Cm*, perpendicular to the Line *AB*; then set off the half breadth, on either side, at the Points *A* and *B*, and draw the two Lines *IA* and *KB*, parallels to *CD*, signifying the breadth of the Vessel 20 Feet; then draw the two Lines *EF* and *HG*, signifying the breadth of the Floor thwart Ships, 8 Feet, more than one third part of the Breadth, though that was the old Proportion; and according to that it should have been but 6 Feet 8 Inches.

Herein any may do as they please, give more or less; my Judgment is, rather more than less: For that it maketh a Vessel carry more in Burden, and I conceive if it be well ended forward, it will not damage the Sailing: I also think it doth stiffen a Vessel on this account. Our *English* Vessels have been used to have their Breadth lying at the Height of the half Breadth, then observing $\frac{1}{3}$ breadth for the length of the Floor thwart Ships, it maketh the Vessel's Body to be very near a Circle, as is a Cask, which causeth such Vessels to be easy to slew in the Water: But the best way to make a Vessel stiff is, that the half breadth be more than the draught of Water, which causeth that the Body be stronger in the Water, and will not slew so easily. Now to sweep out the Sides under Water, draw the Diagonal Lines *DA* and *DB*, then divide the Diagonal Lines into 9 parts, and set off two of them from the Corners *A* and *B* to the point *e*, then set off the dead Rising, which is of 4 Inches, 1 Inch to a Foot, for half the Breadth represented in the Figure, by the little Line parallel to *FG*; from which dead Rising, take with the Compasses the Distance that will draw a piece of an Arch from *f* to *e*, and so as one Foot of the Compasses stand in the Line *EF*, and exactly touch the Points at the dead Rising, at *f* or *g*, and touch also the Point *e*, which Point falls at ⊙ in *EF*, or ⊙ in *HG*, wherewith I describe the Arch *ef*, or *eg*, which is by the Scale 4 Feet 8 Inches: Then for the other part of the side upwards, seek for a Point in the breadth Line *IK*, at which, if one Foot of the Compasses be set, and the other Foot opened to the extreme Breadth,



Breadth, will alſo draw, or ſignify an Arch to meet with the other lower Arch, on the Diagonal Line at *e*, which is at the Points ⊙ and ⊙; thus the Point ⊙, between *D* and *K* near *H*, ſweepeth the contrary ſide *I e*, and ſo the Point ⊙ between *D* and *I*, near *E*, ſweepeth the contrary ſide *e K*; extend the ſame Sweep alſo above the Breadth-line above Water 3 or 4 Feet, the Length of this Sweep is 12 Feet 9 Inches: Then ſet off the Tumbling-home, at the height of the two firſt Hanſes, at the Main-maſt, and Fore-caſtle two Feet on a ſide; then draw a Line from the ſaid 2 Feet of narrowing, at the Points *O* and *V*, 'till it break off on the back of the Sweep, on either ſide. And this kind of Demonſtration I conceive moſt ſuitable to our following Diſcourſe of *Arithmetical Work*.

CHAP. V.

The Deſcription of the Riſing-lines aftward on, and forward on; with the Narrowing-lines, and Lines of Breadth; as alſo the Narrowing-lines at the top of the Timbers.

DRAW a Hanging-line on the Draught, Fig. *C*, from the middle of the Keel to the Height of the Water-line, on the Poſt which will be the Riſing-line, as the Line *DE*; this Line *DE* is ſuppoſed to be ſwept, or drawn by a Semidiameter of a Circle, extended on a Perpendicular raiſed at the Point *E*; for if it be ſhorter than ſuch a Semidiameter of the true Circle, it will make a fuller Line than it ſhould be, and ſo muſt not be ſo long, or elſe it will make a Breach at the beginning of the Line; thus, if the Center be ſuppoſed to be abaft ſuch a Perpendicular, that ſhould draw a Riſing-line abaft, I ſay, that it will ſhorten the Riſing-line, and make it fuller than it ſhould be; or then if it be farther forward, it will be ſtraighter than a Circle, and alſo be a Breach at the beginning of the Riſing-line, afore it ſhould be a Circle, whoſe Semidiameter will be on the Perpendicular-line, at the beginning of any ſuch Riſing-line, on the Heel, either afore or abaft, and the like ought to be for all other crooked Lines, as the Narrowing-lines abaft, or afore, at the Narrowing of the Floor, or other Circular-lines, as hanging of Wails, and the like; the Way whereof I ſhall deſcribe, to find the lengths of all ſuch Sweeps by Arithmetic; as alſo the true riſing, narrowing of any Timber, according to the exact pieces of Circles, very uſeful for the ſetting of Bows, to try whether they hang to a true Sweep or no; I ſhall demonſtrate it in the following Diſcourſe, and in this Place end what I intend to ſay. For Demonſtration then, at $\frac{1}{4}$ of the Keel forward from the Poſt I draw a Riſing-line forward to the height of the Water-line forward on the Stem, as you ſee the Line *OP*; and the little Line, between theſe two Lines, parallel to the Inſide of the Keel, marked *EO*, is the dead Riſing of 4 Inches high, as in the laſt Fig. of the Bend of Moulds it is parallel to *FG*; the height of the breadth from the Mid-ſhip forward, is the lower Edge of the upper Wail; but aftward on it is the Pricked-line, between the Water-line and the lower Wail, on the Poſt, which runneth forward to the Edge of the Wail, and hath Figures ſet to it, to ſignify the

the Places of the Timbers marked 1, 2, 3, 4, 5 to 15; as you see answers to the Figures on the Keel: And the Letters set forward on, signify the Places of the Timbers forward, marked, *A*, *B*, *C*, *D*, &c. to *L*, in the middle of the Vessel: The Places marked with a Cypher, signify the Flats, which have only dead Rising, altho' they ought to have (some of them) something more dead Rising than each other; and those that have least, to be placed in the middle of the rest, that so there be no Clings in the Buldge, but that it have also a little hanging in it, it will seem fairer: Then I draw a strait Line, parallel to the bottom of the Keel, as is the Line *F Q*, parallel to the Line *A B*, the Keel, and distant 10 Feet by the Scale, which is the half breadth of the Vessel; for this Line signifieth a Line stretched from the middle of the Stern-post to the middle of the Stem, called by SHIPWRIGHTS, a Ram-line: Parallel to this Middle-line, I draw another Line strait, marked *n m*, and is 4 Feet from the Middle-line, to signify the half length of the Floor thwart Ships, as in the bend of Moulds *E F* is distant from *D C*, 4 Feet: Then I draw a crooked Line abaft, within this Line *n m*, to signify the narrowing of the Floor, to bring or form the Vessel's Way abaft, as you see the Line *i p* abaft; and afore it is represented by the Line *Q*. Then in this Draught I draw a Sweep, or a piece of a Circle from the Point *G*, the Mark of the Timber *G*, on the Keel, to *g* the half breadth on the Stem, signifying the sweep of the Harping, and is swept by the breadth of the Vessel 20 Feet: The piece of the pricked Circle abaft at the Stern, which is drawn by a Center on the Line *F G*, is the length of the Transom thwart the Stern, as is the Arch *F S*, the length whereof is 8 Feet, which doubled is 16 Feet for the whole length; which is $\frac{2}{5}$, of the breadth 20 Feet, the length of the Sweep that sweepeth it, is the length of the Stern-post to the bottom of the Keel 14 Feet $\frac{4}{5}$, then the crooked Line from the End of the Transom, or from the Point *S*, and toucheth the Keel at the Point *P*. This Arch *S P*, is the Narrowing-line abaft at the breadth, and the crooked Pricked-line within the Keel, marked with *T R*, is a Rising-line, to order a hollow Mould by the Timbers, which are placed at 2 Feet Timber and Room, as you may see by the Scale, and the Line drawn from the Poop to the Fore-castle, marked by the Letters *V W*, is a Line signifying the breadth of the Vessel, at the top of the Side, from the top of the Poop to the Fore-castle, the top of the Poop is in breadth 10 Foot, half the breadth at the Beam; the Use of this Line is in ordering of the Moulds, to steady the Head of the Top-timber Mould, to find the breadth aloft.

CHAP. VI.

Shewing the Making and Graduating, or Marking of the Bend of Moulds.

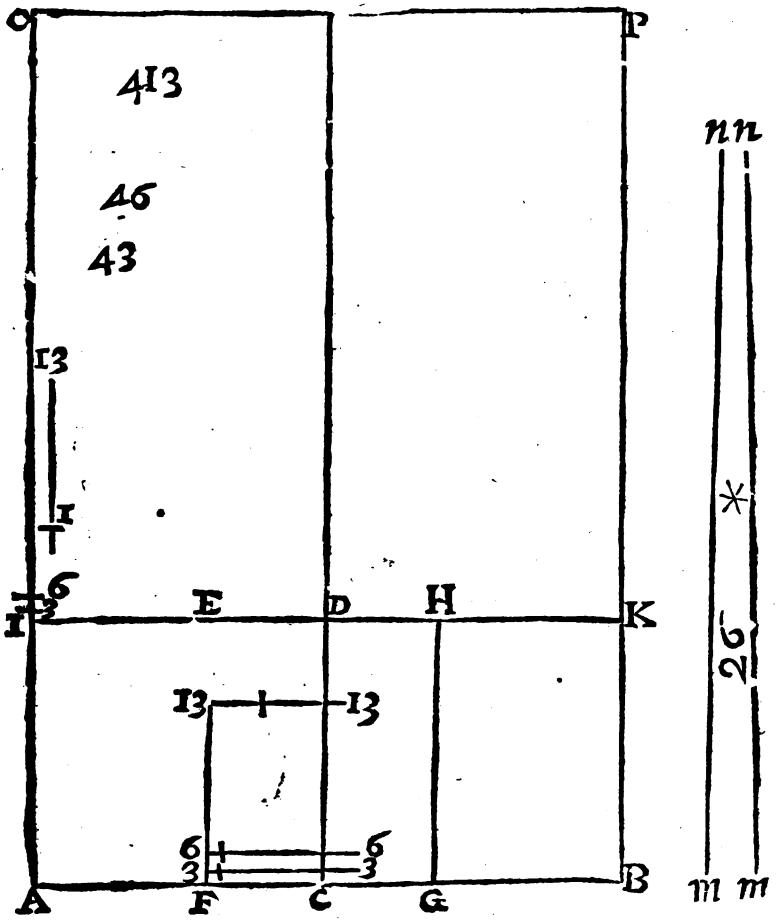
REpair to some House that hath some Room, or other Place, broad enough to demonstrate the breadth of the Vessel, and height enough for the top of the Poop in the length of the Room; or else, if you cannot find such a Room convenient, lay Boards together, or Planks, that may be large enough for your Business, as in the following Scheme you see. First, a long Square made for the Breadth of the Vessel, as in the following Figure *I A B K*: Then make the Moulds by their Sweeps, and make Sir-marks to them, for laying them together in their true Places; first the Mould for the Floor being made, you may make a Sir-mark by the Line *E F*, on the head of the Floor-mould, and another on the foot of the naval Timber-mould, at the same Place, to signify that those two Marks, when put together, they are in their true Places, and will compare so when any Timber are moulded by them: Those Sir-marks must also be marked off on the Timbers, and so in putting the Timbers up in the Frame, a regard being had to compare Sir-marks with Sir-marks, each Timber will find its own Place, and come to his own breadth, and give the Vessel that Form assigned her by your Draught, if it be wrought by it, and for all the other Moulds.

In making your Moulds, that they may be smaller and smaller upwards, and not all of a bigness, you may measure the depth of the side in the Mid-ships circular, as it goeth from the Keel to the top of the side, as here the side, as it roundeth, is 26 Feet, and in depth at the Round-heads, or at the end of the Floor, is one Foot, as *m m*; and at the other end, at the head of the Timber is but half a Foot, as at *n n*, so then drawing two Lines, as the Lines *n m*, represents the diminishing of the Moulds in thickness upwards, as those two Lines representeth; as if you would find the thickness of the Timbers at the breadth, take your 2 Foot-rule, and measure the Length from the end of the Floor at the Point *F* and *I*, at the Breadth in the crooked Body, and it is 11 Feet 9 Inches, signified at the Sir-marks there, those two Lines shew the thick-

ness

neſs to be 9 Inches, and ſo thick ought the Moulds to be at the breadth of the Veſſel.

By this Propoſition, the Moulds being made and Sir-marked to the Body of the Veſſel, and that they muſt be marked, or ordered, to find the decreaſe of her Bulk's Body in the Mid-ſhips, and to come to her way abaft, that the Water may paſs to her Rudder to make her ſteer, repair to the *Draught*, Fig. *C.* and firſt ſet off her Riſings thus: *Example*, We will begin at Timber 3 abaft, and his Riſing is 7 Inches:



There-

Therefore draw a Line parallel to the Baſe, or Ground-line *FG*, as the Line 3 3, 7 Inches from it, then take the Narrowing of the Floor with the Compaſſes off, 3 alſo, and it is here 4 Inches, ſhewed by the little Spot or Croſs in the Riſing-line 3 3, then ſeeking for the narrowing at the breadth for Timber 3, there is none, which ſheweth that ſhe keepeth the ſame breadth at 3 ſtill, 20 Foot; but ſeek for the height of the breadth, and it will lie higher at 3, than in the Mid-ſhips by 6 Inches, ſignified by the little Mark in the Line *AI*, a little above *I*, at the Point 3; then for the breadth at the top of the ſide, find that at the top 3, in the Line *VW*, drawn to that end, and you will find that it is narrower there by 2 Feet 7 Inches, than at the breadth, or tumbleth home ſo much at the height, 24 Feet ſignified by an occult dark Line, drawn from the top of the Poop to the Fore-caſtle, to order the height of the Head of the Top-timber Mould, anſwering to the narrowing of the ſame at the Line *VW*; and this Point for 3 falls at the little Croſs mark'd 3, in the upper part of the Figure. For the next *Example*, we will ſet off on our Platform the riſing Narrowings of Timber 6, and 6 riſeth from the Keel 1 Foot 7 Inches, as you ſee the parallel Line 6 6 for breadth, the ſame ſtill at the breadth, but the height of the breadth is higher by 1 Foot, than at the Mid-ſhip, ſignified by the Mark at 6 in the Line: At the breadth, the Tumbling-home, 1 Foot 7 Inches and a half, at the height of 25 Feet 4 Inches, at the Point 6, and ſo proceed for all the reſt, beginning at 1, till you come aft to the faſhion Pieces; when you have ſet off all the heights of Riſings, narrowings of the Floor, narrowings of the Breadth, height of the Breadth, at the Breadth of the Veſſel, and alſo of the head of the Top-timber; then at each Point of the Floor, ſtick in a Nail, or a Gimblet, or ſome ſuch Thing; as ſuppoſe we begin here at 3, ſtick one in the Mid-ſhip-line at 3; another in the little Croſs, at the narrowing of the Floor at 3; another at the height of the breadth at 3; another at the little Croſs, as at the head of the Top-timber for 3; then, if you have a lower Futtock-mould, and an upper Futtock-mould, otherwiſe a naval Timber-mould and a Futtock-mould, nail them together with ſmall Nails, and lay the Sir-marks of the Floor-mould and Futtock-mould, to the Gimblet that ſticketh at the ſhortning of the Floor, for by this means the Floor-mould and Futtock-mould are haled downward; then make a Mark at the Croſs, in the Mid-ſhip Line *CD*, ſetting to the Mark of 3 for Timber 3, which will be the ſhortning of the Floor; then be ſure the naval Timber-moulds touch the Gimblet at the breadth, and at the narrowing of the Floor, keeping the lower Sir-mark thereto; and make a Mark on the Futtock-mould, at the upper Gimblet, for the Riſing

Rising below lifteth up the Moulds higher; and if there be any crossing at the Foot of the naval Timber, and head of the Floor-mould, mark it, and set the Mark 3 to it, that you may know to lay them together again, and keeping the Futtock-mould fast, lay to the top Timber-mould the breadth Sir-mark of the top Timber-mould, to the Gimblet at the breadth, so have you no more Sir-marks on the top Timber-mould but one, and guide the Head of him till a Line stretched from the Cross, at the Head of the top Timber, compareth with the right part of top Timber-mould, then regard the crossing of the foot of the top Timber-mould, and the back of the Futtock, and mark it, setting the proper Mark 3 to it, that laying those Marks together, they may find their own Places again, so having finished for this Room 3, take up the Moulds, and remove the Gimblets to the next, as to 6, here in our *Example*, and stick the Gimblets at all the Marks of 6; then lay down the Moulds again, laying down the Floor-mould to the Sir-mark of 6, on the narrowing of 6, and to the Gimblet, sticking on the Mid-ship-line of *DC*, and right on the same Line, at the crossing, make a Mark on the Floor-mould, which will be the narrowing of the Floor; then lay down the Futtock-mould, the Sir-mark on the foot to the Gimblet, on the narrowing of the Floor, and keeping the Mould to touch the Gimblets at both Places, make a Mark for the breadth Sir-mark at 6, on the Futtock-mould, and set to it 6; then lay down the top Timber-mould, the breadth Sir-mark thereof to the Gimblet, sticking at the height of the breadth, that the back-side of the upper End may hang fair, by a right Line from the Cross at the upper End of the top Timber at 6, by the back of the top Timber-mould, a strait Line may compare therewith, then keeping fast the Moulds so, till you have marked the crossing of the foot of the top Timber-mould, by the back of the Futtock, mark it on the foot of the top Timber-mould, and set it to the Mark of 6, so that when you are in any other place, as in the Woods a hewing of a Frame, where you hew to every place his Timber, you may be able to lay your Mould together, and mould it according to your Draught. We will lay down the taking of one bend of Timbers more aft, where the breadth is narrowed, as at Timber 13, take his Rising off, and measure it by the Scale, and it will be 6 Foot 8 Inches, which set off on your Platform, and draw thereto a parallel Line to the ground Line *AB*, as is the Line 13, 13, then take off the narrowing of the Floor, as at 13, it is 2 Foot 2 Inches; set that off on the Line 13, from the Line *EF*, as at the little Cross thereon, then take off the narrowing of the breadth at 13, and it will be 8 Inches; draw therewith a little parallel Line, parallel to *IO*, as is the parallel Line

Line 13, 13, then ſeek the height of the breadth, as at 13, it will be from the upper edge of the Keel 12 Foot 3 Inches, and croſſes the parallel Line at the lower end of it, juſt then for the tumbling of the top Timber it will be 3 Foot 3 Inches, and at the height of 27 Foot 7 Inches, at the little Croſs 13. Now, for the order of the hollow Mould, the little round piece of an Arch, in the Skegg of the Veſſel, there take off all the Riſings, and mark them on the Riſing-ſtaff, on one Edge, that they may be known from the other Riſings; as here, for Timber 13, take off the hollow Riſing, which will be at 1 Foot 10 Inches, ſet it off on the riſing Staff, at 1 Foot 10 Inches from one End, and the Uſe of it will be in the Moulding; ſet off the height of this hollow Riſing, on the middle Line of the Timber, when the Moulds are laid to paſs, and ſtrike a Line from this Riſing, on the middle Line until it break off on the back of the Moulds, then lay the hollow Mould to the lower part of the Breech of the Timber, and at the half breadth of the Keel, and ſo bear in the other End till it juſt touch the ſtrait Line, made by the hollow Riſing, and the back of the Moulds; and this mouldeth the lower Part, or Breach of the Timber, and bringeth in the Hollow very fair: The ſame Orders may be obſerved afore, as abaft, on the other ſide of the Moulds, and marked with Letters, to be known from them abaft. Then for the height of your Wails, you may make a Mark at every third or fourth Timber which you reſolve to make Frame-timbers; I ſay, you may make a Mark at every third or fourth Timber, for the height of the upper edge, or lower edge of the Wail, and ſo bring on the Wail fair by thoſe Marks on the one ſide, and with a Level find the height of the other ſide by the former.

Now I have briefly touched the Demonſtration of a Ship by *Projection*; I ſhall now come to an *Arithmetical Way*, far ſurpaſſing any Geometrical Demonſtration, for Exactneſs.

CHAP.

CHAP. VII.

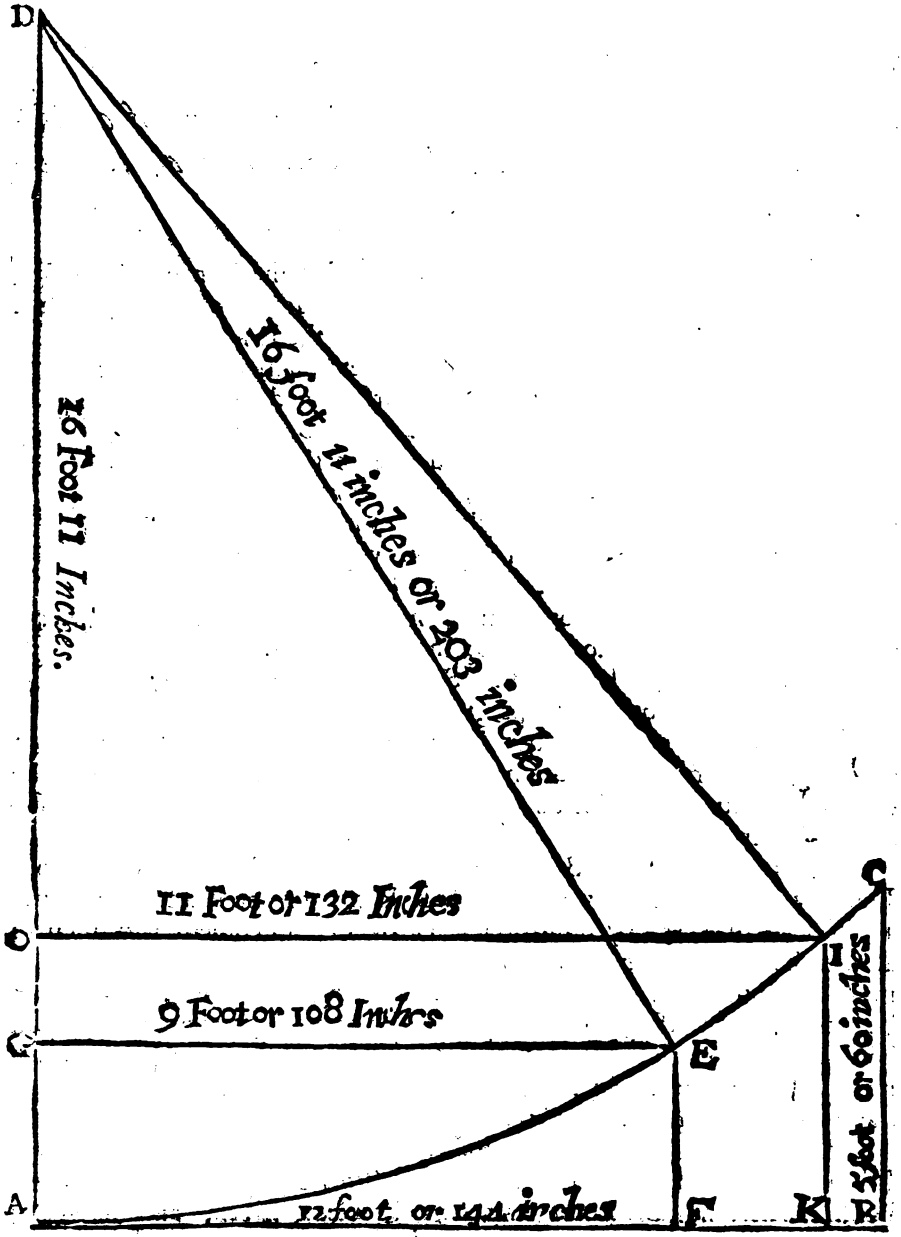
Arithmetically shewing how to frame the Body of a Ship by Segments of Circles; being a true Way to examine the Truth of a Bow.

LET *AB*, in the following Figure, represent the Length of a rising Line 12 Feet long, or 144 Inches, the Height of it *BC*, 5 Feet or 60 Inches, to find the side *DE*, or *DA*, the Radius of the Circle *AC*, whereto *AD* is the Semidiameter; multiply the side *AB* 144 Inches in itself, and so cometh 20736, which Sum divide by the side *BC*, the height of the Rising 60 Inches, and so cometh 345, and $\frac{36}{60}$, which is abbreviated $\frac{3}{5}$; unto this 345 $\frac{3}{5}$ must be added again the height of the Rising, *BC*, 60, which makes 405 $\frac{3}{5}$ of an Inch, which is the whole Diameter of the Circle, the half whereof is 202 Inches $\frac{1}{2}$, and something more near $\frac{1}{4}$, therefore we will avoid the Fraction, and account 203 Inches, or 16 Feet 11 Inches, which is the length of the Sweep, or the side *DE*; and so in all other Sweeps given whatsoever, the Rule is general, and holds true in all things: As to find the Sweep at once, that will round any Beam, or other piece of Timber that is to be swept, remember that, if it be a Beam, you are to find the Sweep but for half of its length.

144
144
576
576
144
20736

23 (3
22736 (345
6883
66

Example: As, if the Beam be 30 Feet in length, and to round one Foot, you must work by 15, the half length of the Beam; and turn 15 Feet into Inches, by multiplying 15 by 12, so cometh 180 Inches: Remember the length of the Rising-line, if it be to find the Sweep, must be multiplied by itself, or the half length of the Timber must be multiplied by itself, as 180 by 180, so cometh 32400, which must be divided by 12 the rounding, cometh in the Quotient 2700, to which must be added the 12 again, the rounding of the Piece, and so it is 2712 the whole Diameter of the Circle, the half of this 2712 is 1356 for the length of the Sweep, or Semidiameter of the Circle, and so in all other Matters where the Sweep is required: This I read in Mr. *Gunter*'s Book, where he calls it the half Chord, being given, and the versed



Sine, to find the Diameter and Semidiameter of the Circle thereto belonging. Now this half Chord in our Work, is the Length of the Rising-line, and the height of the rising on the Poſt is that in our Work, which he repreſents by the Name of the verſed Sine; where remember to multiply the length of the Rising-line by itſelf, if it be a Rising-line, and divide by the height of the Riſing, and to the Quotient add again the height of the Riſing; ſo have you always the whole Diameter of the Circle; divide it by 2, ſo have you the length of the Sweep, or Semidiameter of the Circle.

Example in the Draught foregoing, Fig. C.

Where the length of the Riſing-line is, from the Point *E* to the Point *i*, 32 Feet; and half the height thereof is the Line *D i*, 10 Feet: Turn both Sums into Inches, as 32 Feet multiplied by 12 produceth (adding the ½ Foot, 6 Inches) 390 Inches length of the Riſing-line: Then turn the height of the Riſing into Inches, as 10 Feet multiplied by 12 produceth 120 Inches, from which 4 Inches muſt be ſubtracted, becauſe the dead Riſing is 4 Inches, ſo then the Height is 116 Inches: Now multiply the length 390 Inches by itſelf, makes 152100.

390
390
000
3510
1170
152100

This Multiplication of the Sum 152100 muſt be divided by 116 Inches, the height of the Riſing, and ſo cometh in the Quotient of the Diviſion 1311 Inches, unto this 1311 Inches muſt be added the 116 Inches, the height of the Riſing 116/1427, and it maketh 1427, which is the whole Diameter of the Circle; divide it by 2, to find the half of it, ſo have you in the Quotient 713 Inches ½ Inch for the length of the Sweep, which divided by 12, to bring it into Feet, maketh 59 Feet 5 Inches and a half; and ſo for all other circular Lines whatever, when the Length is known, and the rounding of them alſo known: As for the hanging of Wails, the height of them known in the Mid-ſhips from the Keel, ſubtracted from the height, at the Poſt, and that will be the hanging of them, which is the ſame with the height of the Riſing-line on the Poſt, in the *Arithmetical* Work, and is the ſame with the verſed Sine in *Geometry*. Theſe Examples, I think, ſufficient to ſignify the Conſtruction of this way of working by Sweeps.

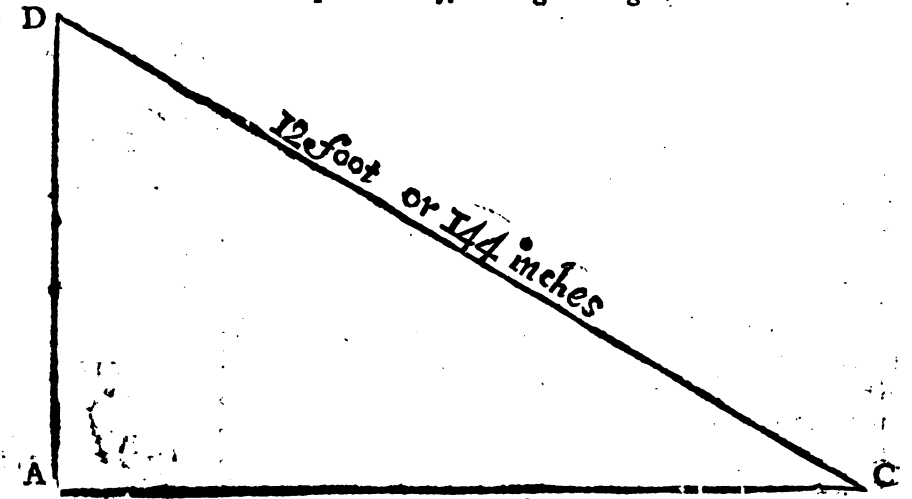
212
3323
46344
152100(1311
116666
1111
XX
I
1427 (713
222

It followeth now, that I ſhew the Manner of finding the Riſings of Timbers by *Arithmetick* alſo.

To find the Rising of the Line F E *in the Figure foregoing.*

The Sweep being first found to be as before 203 Inches, as the side *D E* signifieth, then there is known the side *E G*, 108 Inches; now these two Sides being given, we are to find the third Side *D C*, so here is made a right angled Triangle, two Sides thereof are given to find a third, which to do, proceed thus: Multiply the two Sides given, by themselves, and subtract the Multiplication of the shortest Side, from the Multiplication made of the other Side, and extract the square Root of the Remainder, so have you the third Side sought.

Example in the following Triangle.



10 *Feet, or* 120 *Inches.*

Having the Side *D C*, 12 Feet, which is 144 Inches, and the Side *A C*, 10 Feet, otherwise 120 Inches; to find the Side *D A*, multiply the Sides given into themselves, which is called Squaring of them: As, multiply the Side *D C*, 144 Inches by 144 Inches, so cometh 20736; then multiply the other Side *A C* 120 also by itself, so cometh in the Quotient 14400, which must be subtracted from the other Multiplication, as you see, so cometh the Quotient 6336, from which the greatest Square must be extracted, called the Extraction of the square Root, which is 79 Inches, and almost another by the Fraction; that is, 6 Feet and very near 8 Inches.

144
144
576
576
144
20736

120
120
000
240
120
14400

20736
14400
6336

Note,

Note, These Demonstrations, this and the former, are laid down by the Scale, projected for Demonstration, at the Beginning of this Book.

1
595
147
6336 (79
14

Another Example.

So in the last Figure foregoing but one, the side *D E*, 203 Inches, which squared, or multiplied in itself, is 41209.

203
203
609
000
406
41209

Then the other side *G E*, 108, multiplied in itself, which is squaring of it, 11664, as you see.

108
108
864
000
168
11664

Which subtracted from the other Multiplication, as 11664 subtracted from 41209, resteth 29545, the square Root extracted from it, or the side of the greatest Square that can be taken from the Subtraction being found, is 171 and $\frac{1}{4}$, which 171 $\frac{1}{4}$, subtracted from 203: The length of the Sweep for one side resteth 31 Inches $\frac{3}{4}$, for the rising of the Line *E F*, and the like for any other Rising.

41209
11664
29545

(3
156 (08
29549 (171
2
34

Another Example.

As at the Place *K I*, the Rising thereof is required, the side *D I* is as *D E*, 203 Inches.

Note, The Length of the Sweep being found, always is one of the Sides, in the finding the Rising of any Timber, and is always one of the Numbers, which when you have squared, note in a piece of Paper by itself, where you may always see what it is: So that in the finding of Rising, after the Sweep is found, all you have to do, is to know how many Feet,

Feet, or Inches, the Timber you ſeek for is removed from the Beginning, or Foot of the Riſing-line, which is the ſecond Side, and in the third *Example* it is 11 Feet, or 132 Inches, for ſo much *K I* is from the Foot of the Line *A*, which ſquared is 17424, and muſt be ſubtracted from the Square made of Radius, which in the other *Example* is 41209, and ſo reſteth 23785, from which extract the ſquare Root, and it is 154 Inches and $\frac{1}{4}$, which ſubtracted from the length of the Sweep, leaveth 48 Inches $\frac{1}{4}$, or 4 Feet and $\frac{1}{4}$ of an Inch, and ſo much is the Riſing of the ſaid Timber. One *Example* in the *Draught*, Fig. *C*. the length of that Sweep we found heretofore to be 713 Inches, then we will ſeek to find the Riſing for Timber 13, ſtanding aft from the Point *E*, or foot of the Riſing-line 324 Inches, theſe are the given Sides: Then proceed, ſquare the Semidiameter of the Sweep 713, it maketh 508369; then ſquare the diſtance of the Timber 13, which is 324, and it maketh 104976; theſe ſubtracted from the former Figures, reſteth 403387, the ſquare Root thereof is 635 $\frac{1}{4}$ neareſt, which ſubtracted from the Radius 713, reſteth 77 Inches and $\frac{1}{4}$, or 6 Feet 5 Inches $\frac{1}{4}$, which with 4 Inches Dead-riſing, is 6 Feet 9 Inches $\frac{1}{4}$, and ſo much is the riſing of the Timber 13 from the Keel.

132
132
264

396
132
17424

41209
17424
23785

10
132 (69
23785 (154
· a · 0 ·
3

The ſquare Root being of ſuch great Uſe in Ship-building, and ſome, tho' ingenious Workmen, not knowing how to perform it, I have next inſerted a Table of the ſquare Root of all Numbers to 1690000, and the Squares of all Numbers to 1300.

Inch.	Feet. Inches.	Squares.	Inch.	Feet. Inches.	Squares.	Inch.	Feet. Inches.	Squares.
1	1	1	51	4 3	2601	101	8 5	10201
2	2	4	52	4 4	2704	102	8 6	10404
3	3	9	53	4 5	2809	103	8 7	10609
4	4	16	54	4 6	2916	104	8 8	10816
5	5	25	55	4 7	3025	105	8 9	11025
6	6	30	56	4 8	3136	106	8 10	11236
7	7	49	57	4 9	3249	107	8 11	11449
8	8	64	58	4 10	3364	108	9 00	11664
9	9	81	59	4 11	3481	109	9 1	11881
10	10	100	60	5 00	3600	110	9 2	12100
11	11	121	61	5 1	3721	111	9 3	12321
12	1 00	144	62	5 2	3844	112	9 4	12544
13	1 1	169	63	5 3	3964	113	9 5	12769
14	1 2	196	64	5 4	4096	114	9 6	12996
15	1 3	225	65	5 5	4225	115	9 7	13225
16	1 4	256	66	5 6	4356	116	9 8	13456
17	1 5	289	67	5 7	4489	117	9 9	13689
18	1 6	324	68	5 8	4624	118	9 10	13924
19	1 7	361	69	5 9	4761	119	9 11	14162
20	1 8	400	70	5 10	4900	120	10 00	14400
21	1 9	441	71	5 11	5041	121	10 1	14641
22	1 10	484	72	6 00	5184	122	10 2	14884
23	1 11	529	73	6 1	5329	123	10 3	15229
24	2 00	576	74	6 2	5476	124	10 4	15376
25	2 1	625	75	6 3	5625	125	10 5	15625
26	2 2	676	76	6 4	5776	126	10 6	15876
27	2 3	729	77	6 5	5920	127	10 7	16029
28	2 4	784	78	6 6	6084	128	10 8	16384
29	2 5	841	79	6 7	6241	129	10 9	16641
30	2 6	900	80	6 8	6400	130	10 10	16600
31	2 7	961	81	6 9	6561	131	10 11	17161
32	2 8	1024	82	6 10	6724	132	11 00	17424
33	2 9	1089	83	6 11	6889	133	11 1	17689
34	2 10	1156	84	7 00	7056	134	11 2	17956
35	2 11	1225	85	7 1	7225	135	11 3	18225
36	3 00	1296	86	7 2	7396	136	11 4	18496
37	3 1	1369	87	7 3	7569	137	11 5	18769
38	3 2	1444	88	7 4	7744	138	11 6	19044
39	3 3	1521	89	7 5	7921	139	11 7	19321
40	3 4	1600	90	7 6	8100	140	11 8	19600
41	3 5	1681	91	7 7	8281	141	11 9	19081
42	3 6	1764	92	7 8	8464	142	11 10	20164
43	3 7	1849	93	7 9	8649	143	11 11	20449
44	3 8	1936	94	7 10	8836	144	12 00	20736
45	3 9	2025	95	7 11	9025	145	12 1	21025
46	3 10	2116	96	8 00	9226	146	12 2	21416
47	3 11	2209	97	8 1	9409	147	12 3	21609
48	4 00	2304	98	8 2	9604	148	12 4	21904
49	4 1	2401	99	8 3	9801	149	12 5	22201
50	4 2	2500	100	8 4	10000	150	12 6	22500

Inch.	Feet. Inches.	Squares.	Inch.	Feet Inches.	Squares.	Inch.	Feet. Inches.	Squares.
151	12 7	22801	201	16 9	40401	251	20 11	63001
152	12 8	23104	202	16 10	40844	252	21 00	63504
153	12 9	23409	203	16 11	41209	253	21 1	64009
154	12 10	23716	204	17 00	41616	254	21 2	64516
155	12 11	24025	205	17 1	42025	255	21 3	65025
156	13 00	24336	206	17 2	42436	256	21 4	65536
157	13 1	24649	207	17 3	42849	257	21 5	66049
158	13 2	24964	208	17 4	43264	258	21 6	66564
159	13 3	25381	209	17 5	43681	259	21 7	67081
160	13 4	25600	210	17 6	44100	260	21 8	67600
161	13 5	25921	211	17 7	44521	261	21 9	68121
162	13 6	26244	212	17 8	44944	262	21 10	68644
163	13 7	26569	213	17 9	45369	263	21 11	69169
164	13 8	26956	214	17 10	45796	264	22 00	69596
165	13 9	27225	215	17 11	46224	265	22 1	70425
166	13 10	27556	216	18 00	46656	266	22 2	70756
167	13 11	27886	217	18 1	47089	267	22 3	71289
168	14 00	28224	218	18 2	47524	268	22 4	71824
169	14 1	28561	219	18 3	47961	269	22 5	72361
170	14 2	28900	220	18 4	48400	270	22 6	72900
171	14 3	29241	221	18 5	48841	271	22 7	73441
172	14 4	29584	222	18 6	49284	272	22 8	73984
173	14 5	29929	223	18 7	49729	273	22 9	74529
174	14 6	30276	224	18 8	50176	274	22 10	74072
175	14 7	30625	225	18 9	50625	275	22 11	75575
176	14 8	31076	226	18 10	51076	276	23 00	76176
177	14 9	31329	227	18 11	51529	277	23 1	76729
178	14 10	31684	228	19 00	51984	278	23 2	77284
179	14 11	32041	229	19 1	52441	279	23 3	77841
180	15 00	32400	230	19 2	52900	280	23 4	78400
181	15 1	32761	231	19 3	53361	281	23 5	78961
182	15 2	33124	232	19 4	53824	282	23 6	79524
183	15 3	33488	233	19 5	54289	283	23 7	80089
184	15 4	33856	234	19 6	54656	284	23 8	80656
185	15 5	34025	235	19 7	55225	285	23 9	81225
186	15 6	34596	236	19 8	55691	286	23 10	81796
187	15 7	34969	237	19 9	56069	287	23 11	82369
188	15 8	35344	238	19 10	56644	288	24 00	82944
189	15 9	35721	239	19 11	57121	289	24 1	83521
190	15 10	36100	240	20 00	57600	290	24 2	84100
191	15 11	36481	241	20 1	58081	291	24 3	84681
192	16 00	36864	242	20 2	58564	292	24 4	85264
193	16 1	37249	243	20 3	59049	293	24 5	85849
194	16 2	37636	244	20 4	59536	294	24 6	86836
195	16 3	38025	245	20 5	60025	295	24 7	87025
196	16 4	38416	246	20 6	60516	296	24 8	87616
197	16 5	38809	247	20 7	61009	297	24 9	88209
198	16 6	39204	248	20 8	61504	298	24 10	88804
199	16 7	39601	259	20 9	62001	299	24 11	89401
200	16 8	4.000	250	20 10	62500	300	25 00	90000

Inch.	Feet.	Inches.	Squares.
301	25	1	90601
302	25	2	91204
303	25	3	91809
304	25	4	92416
305	25	5	93025
306	25	6	93636
307	25	7	94241
308	25	8	94864
309	25	9	95481
310	25	10	96100
311	25	11	96721
312	26	00	97344
313	26	1	97969
314	26	2	98596
315	26	3	99225
316	26	4	99856
317	26	5	100489
318	26	6	101124
319	26	7	101761
320	26	8	102400
321	26	9	103041
322	26	10	103684
323	26	11	104329
324	27	00	104976
325	27	1	105625
326	27	2	106276
327	27	3	106929
328	27	4	107584
329	27	5	108241
330	27	6	108900
331	27	7	109561
332	27	8	110224
333	27	9	110889
334	27	10	111556
335	27	11	112225
336	28	00	112896
337	28	1	113569
338	28	2	114244
339	28	3	114921
340	28	4	115600
341	28	5	116281
342	28	6	116964
343	28	7	117349
344	28	8	118336
345	28	9	119025
346	28	10	119716
347	28	11	120409
348	29	00	121104
349	29	1	121801
350	29	2	122505
351	29	3	123206
352	29	4	123909
353	29	5	124604
354	29	6	125311
355	29	7	126025
356	29	8	126736
357	29	9	127449
358	29	10	128164
359	29	11	128881
360	30	00	129600
361	30	1	130321
362	30	2	131044
363	30	3	131779
364	30	4	132496
365	30	5	133225
366	30	6	133956
367	30	7	134689
368	30	8	135424
369	30	9	136161
370	30	10	136900
371	30	11	137640
372	31	00	138384
373	31	1	139129
374	31	2	139876
375	31	3	140625
376	31	4	141676
377	31	5	142129
378	31	6	142984
379	31	7	143641
380	31	8	144400
381	31	9	145161
382	31	10	145924
383	31	11	146689
384	32	00	147456
385	32	1	148225
386	32	2	149006
387	32	3	149769
388	32	4	150544
389	32	5	151321
390	32	6	152210
391	32	7	152881
392	32	8	153664
393	32	9	154440
394	32	10	155236
395	32	11	156025
396	33	00	156816
397	33	1	157609
398	33	2	158104
399	33	3	159201
400	33	4	160000
401	33	5	160801
402	33	6	161604
403	33	7	162409
404	33	8	163216
405	33	9	164025
406	33	10	164836
407	33	11	165649
408	34	00	166464
409	34	1	167281
410	34	2	168100
411	34	3	168921
412	34	4	169744
413	34	5	170569
414	34	6	171396
415	34	7	172225
416	34	8	173056
417	34	9	173889
418	34	10	174724
419	34	11	175561
420	35	00	176400
421	35	1	177241
422	35	2	178084
423	35	3	178959
424	35	4	179776
425	35	5	180625
426	35	6	181476
427	35	7	182329
428	35	8	183184
429	35	9	184041
430	35	10	184900
431	35	11	185761
432	36	00	186624
433	36	1	187789
434	36	2	188356
435	36	3	189825
436	36	4	190096
437	36	5	190999
438	36	6	191044
439	36	7	192721
440	36	8	193600
441	36	9	194481
442	36	10	195364
443	36	11	196249
444	37	00	197136
445	37	1	198025
446	37	2	198916
447	37	3	199809
448	37	4	200704
449	37	5	201601
450	37	6	202509

Inch.	Feet Inches.		Squares.	Inch.	Feet. Inches.		Squares.	Inch.	Feet Inches.		Squares.
451	37	7	203401	501	41	9	251001	551	45	11	303601
452	37	8	204304	502	41	10	252004	552	46	00	304704
453	37	9	205290	503	41	11	253009	553	46	1	305809
454	37	10	206116	504	42	00	254016	554	46	2	306916
455	37	11	207025	505	42	1	255025	555	46	3	308025
456	38	00	207936	506	42	2	256036	556	46	4	309136
457	38	1	208849	507	42	3	257049	557	46	5	310249
458	38	2	209764	508	42	4	258064	558	46	6	311364
459	38	3	210681	509	42	5	269081	559	46	7	312481
460	38	4	211600	510	42	6	260100	560	46	8	313600
461	38	5	212521	511	42	7	261121	561	46	9	314721
462	38	6	213444	512	42	8	262144	562	46	10	315844
463	38	7	214369	513	42	9	263169	563	46	11	316969
464	38	8	215296	514	42	10	264196	564	47	00	318096
465	38	9	216225	515	42	11	265225	565	47	1	319225
466	38	10	217156	516	43	00	266256	566	47	2	320356
467	38	11	218089	517	43	1	267289	567	47	3	321489
468	39	00	219024	518	43	2	268324	568	47	4	322624
469	39	1	219961	519	43	3	269361	569	47	5	323761
470	39	2	220900	520	43	4	270400	570	47	6	324900
471	39	3	221841	521	43	5	271441	571	47	7	326041
472	39	4	222784	522	43	6	272448	572	47	8	327184
473	39	5	223729	523	43	7	273529	573	47	9	328329
474	39	6	224676	524	43	8	274576	574	47	10	330276
475	39	7	225625	525	43	9	275605	575	47	11	330625
476	39	8	226576	526	43	10	276676	576	48	00	331776
477	39	9	227429	527	43	11	277729	577	48	1	332929
478	39	10	228484	528	44	00	278784	578	48	2	334084
479	39	11	229141	529	44	1	280241	579	48	3	335241
480	40	00	230400	530	44	2	280900	580	48	4	336400
481	40	1	231361	531	44	3	281961	581	48	5	337561
482	40	2	232324	532	44	4	284024	582	48	6	338724
483	40	3	233289	533	44	5	287089	583	48	7	340089
484	40	4	234256	534	44	6	285156	584	48	8	341056
485	40	5	235225	535	44	7	286225	585	48	9	342205
486	40	6	236196	536	44	8	287296	586	48	10	343396
487	40	7	237169	537	44	9	288369	587	48	11	344669
488	40	8	238144	538	44	10	290444	588	49	00	345744
489	40	9	239121	539	44	11	290521	589	49	1	346921
490	40	10	240100	540	45	00	291600	590	49	2	348100
491	40	11	240981	541	45	1	292681	591	49	3	349281
492	41	00	242064	542	45	2	293764	592	49	4	350464
493	41	1	243049	543	45	3	294849	593	49	5	351649
494	41	2	244036	544	45	4	295936	594	49	6	352836
495	41	3	245025	545	45	5	297025	595	49	7	353925
496	41	4	246016	546	45	6	298916	596	49	8	354216
497	41	5	246009	547	45	7	299209	597	49	9	355409
498	41	6	247004	548	45	8	300307	598	49	10	356604
499	41	7	249001	549	45	9	301401	599	49	11	358801
500	41	8	250000	550	45	10	302500	600	50	00	460000

Inch.	Feet.	Inches.	Squares.	Inch.	Feet.	Inches.	Squares.	Inch.	Feet.	Inches.	Squares.
601	50	1	361201	651	54	3	423801	701	58	5	491401
602	50	2	362404	652	54	4	425104	702	58	6	492804
603	50	3	363609	653	54	5	426403	703	58	7	494209
604	50	4	364816	654	54	6	427716	704	58	8	495616
605	50	5	366025	655	54	7	429025	705	58	9	497025
606	50	6	367236	656	54	8	430336	706	58	10	498436
607	50	7	368449	657	54	9	431449	707	58	11	498849
608	50	8	369664	658	54	10	432969	708	59	00	501264
609	50	9	370881	659	54	11	434181	709	59	1	502681
610	50	10	372100	660	55	00	435600	710	59	2	504100
611	50	11	373321	661	55	1	436921	711	59	3	505525
612	51	00	374544	662	55	2	438244	712	59	4	506944
613	51	1	375769	663	55	3	439569	713	59	5	508669
614	51	2	376996	664	55	4	440896	714	59	6	509796
615	51	3	378225	665	55	5	442225	715	59	7	511225
616	51	4	379456	666	55	6	443556	716	59	8	512656
617	51	5	380689	667	55	7	444889	717	59	9	514089
618	51	6	381924	668	55	8	446224	718	59	10	515824
619	51	7	383161	669	55	9	447561	719	59	11	516961
620	51	8	384400	670	55	10	448900	720	60	00	518400
621	51	9	385641	671	55	11	450241	721	60	1	519841
622	51	10	386884	672	56	00	451544	722	60	2	521284
623	51	11	388129	673	56	1	452829	723	60	3	522729
624	52	00	389376	674	56	2	454276	724	60	4	524176
625	52	1	390625	675	56	3	455625	725	60	5	525625
626	52	2	391876	676	56	4	456976	726	60	6	526976
627	52	3	393129	677	56	5	458329	727	60	7	528529
628	52	4	394384	678	56	6	459684	728	60	8	529984
629	52	5	395641	679	56	7	461041	729	60	9	521421
630	52	6	396900	680	56	8	462400	730	60	10	522900
631	52	7	398161	681	56	9	463761	731	60	11	524361
632	52	8	399424	682	56	10	465124	732	61	00	535844
633	52	9	400489	683	56	11	466489	733	61	1	537289
634	52	10	401956	684	57	00	467856	734	61	2	538656
635	52	11	403225	685	57	1	469225	735	61	3	540225
636	53	00	404496	686	57	2	470596	736	61	4	541696
637	53	1	405769	687	57	3	471939	737	61	5	543169
638	53	2	407044	688	57	4	473344	738	61	6	544644
639	53	3	408321	689	57	5	475721	739	61	7	546031
640	53	4	409600	690	57	6	4767 •	740	61	8	547600
641	53	5	410881	691	57	7	477841	741	61	9	549081
642	53	6	412164	692	57	8	478864	742	61	10	550564
643	53	7	413449	693	57	9	480269	743	61	11	552049
644	53	8	414736	694	57	10	481636	744	62	00	553436
645	53	9	416025	695	57	11	482825	745	62	1	555025
646	53	10	417316	696	58	00	484416	746	62	2	556516
647	53	11	418609	697	58	1	485809	747	62	3	558009
648	54	00	429904	698	58	2	487204	748	62	4	559504
649	54	1	421201	699	58	3	488601	749	62	5	561001
650	54	2	422500	700	58	4	490000	750	62	6	562500

Inch.	Feet. Inches.	Squares.	Inch.	Feet. Inches.	Squares.	Inch.	Squares.
751	62 7	564001	801	66 9	641601	851	724201
752	62 8	565504	802	66 10	642204	852	725904
753	62 9	567009	803	66 11	644809	853	727609
754	62 10	568516	804	67 00	646416	854	729216
755	62 11	570025	805	67 1	648025	855	721025
756	63 00	571536	806	67 2	649836	856	732736
757	63 1	573049	807	67 3	651249	857	734449
758	63 2	574564	808	67 4	652864	858	736164
759	63 3	576081	809	67 5	654481	859	737681
760	63 4	577600	810	67 6	656100	860	739600
761	63 5	579121	811	67 7	657721	861	741321
762	63 6	580644	812	67 8	659344	862	743044
763	63 7	582169	813	67 9	660969	863	744769
764	63 8	583696	814	67 10	662596	864	746396
765	63 9	585225	815	67 11	664225	865	748225
766	63 10	586756	816	68 00	665856	866	749956
767	63 11	588289	817	68 1	667429	867	753689
768	64 00	589824	818	68 2	669124	868	753824
769	64 1	591361	819	68 3	671771	869	755161
770	64 2	592900	820	68 4	672400	870	756900
771	64 3	594441	821	68 5	674041	871	758641
772	64 4	595984	822	68 6	675684	872	760384
773	64 5	597529	823	68 7	677329	873	762129
774	64 6	599076	824	68 8	678976	874	763776
775	64 7	600625	825	68 9	680625	875	765625
776	64 8	602176	826	68 10	682276	876	767376
777	64 9	604729	827	68 11	684129	877	769129
778	64 10	606284	828	69 00	685584	878	770884
779	64 11	607841	829	69 1	688241	879	772641
780	65 00	608400	830	69 2	688900	880	774400
781	65 1	609961	831	69 3	689661	881	777161
782	65 2	611524	832	69 4	692224	882	777924
783	65 3	613099	833	69 5	693889	883	779589
784	65 4	614656	834	69 6	695556	884	781456
785	65 5	616225	835	69 7	697225	885	783225
786	65 6	617796	836	69 8	698896	886	784996
787	65 7	619369	837	69 9	700169	887	786769
788	65 8	620944	838	69 10	702244	888	788544
789	65 9	622521	839	69 11	703921	889	790321
790	65 10	624100	840	70 00	705600	890	792100
791	65 11	625681	841	70 1	707281	891	793081
792	66 00	627964	842	70 2	708964	892	795564
793	66 1	628849	843	70 3	710649	893	797449
794	66 2	630466	844	70 4	711336	894	799236
795	66 3	632125	845	70 5	714025	895	801025
796	66 4	633616	846	70 6	715716	896	802816
797	66 5	635209	847	70 7	717309	897	804609
798	66 6	637404	848	70 8	719004	898	805904
799	66 7	638401	849	70 9	720801	899	808201
800	66 8	640000	850	70 10	722500	900	810000

Inch.	*Squares.*	*Inch*	*Squares.*	*Inch.*	*Squares.*	*Inch.*	*Squares.*
901	811801	951	904401	1001	1002001	1051	1104601
902	813604	952	906304	1002	1004004	1052	1106704
903	815409	953	908209	1003	1006009	1053	1108809
904	817216	954	910016	1004	1008016	1 54	1110916
905	819025	955	912025	1005	1010025	1055	1113025
906	820836	956	913936	1006	1012036	1056	1115136
907	822649	957	915849	1007	1014049	1057	1117249
908	824464	958	917764	1008	1016064	1058	1119364
909	826281	959	919681	1009	1018081	1059	1120489
910	828100	960	921600	1010	1020100	1060	1123600
911	829921	961	923521	1011	1022121	1061	1125721
912	831741	962	926444	1012	1024104	1062	1127844
913	833569	963	928369	1013	1026196	1063	1129969
914	835369	964	929296	1014	1028196	1064	1132096
915	837225	965	931225	1015	1030225	1065	1134225
916	839056	966	933256	1016	1032256	1066	1136358
917	840789	967	935089	1017	1034289	1067	1138489
918	842724	968	937024	1018	1036324	1068	1140624
919	844561	969	939961	1019	1038361	1069	1142761
920	846400	970	940900	1020	1040400	1070	1144900
921	847241	971	942741	1021	1042441	1071	1147041
922	850084	972	944784	1022	1044284	1072	1149184
923	851929	973	946729	1023	1046529	1073	1151329
924	853746	974	948676	1024	1048576	1074	1153476
925	855625	975	950625	1025	1050625	1075	1155625
926	857479	976	952576	1026	1052676	1076	1157976
927	859329	977	954529	1027	1054729	1077	1159929
928	861184	978	956484	1028	1056784	1078	1162074
929	863041	979	958441	1029	1058841	1079	1164241
930	864900	980	960400	1030	1060900	1080	1166400
931	866761	981	962361	1031	1060961	1081	1168561
932	868624	982	964324	1032	1065024	1082	1170724
933	870489	983	966289	1033	1067089	1083	1172889
934	872356	984	968256	1034	1069156	1084	1175056
935	874225	985	970225	1035	1071225	1085	1177225
936	876096	986	972196	1036	1073296	1086	1179396
937	877869	987	974169	1037	1075369	1087	1181569
938	879844	988	976144	1038	1077444	1088	1183744
939	881721	989	978121	1039	1079521	1089	1185921
940	883600	990	980100	1040	1081600	1090	1188100
941	885481	991	982081	1041	1082681	1091	1190281
942	886364	992	984064	1042	1085764	1092	1192464
943	889249	993	986049	1043	1087849	1093	1194649
944	881136	994	988036	1044	1089936	1094	1196836
945	893025	995	990025	1045	1092025	1095	1199025
946	894916	996	992016	1046	1094106	1096	1201216
947	896809	997	994009	1047	1096209	1097	1203409
948	898704	998	996004	1048	1098304	1098	1205604
949	900601	999	998001	1049	1000401	1099	1207801
950	902500	1000	1000000	1050	1002550	1100	1210000

Inch.	*Squares.*	*Inch.*	*Squares.*	*Inch*	*Squares.*	*Inch.*	*Squares.*
1101	1212201	1151	1324801	1201	1442401	1251	1565001
1102	1214404	1152	1327104	1202	1444804	1252	1567504
1103	1216609	1153	1329409	1203	1447209	1253	1570009
1104	1218816	1154	1331716	1204	1440616	1254	1572416
1105	1221025	1155	1334025	1205	1452025	1255	1575021
1106	1223396	1156	1336336	1206	1454436	1256	1577536
1107	1225449	1157	1338649	1207	1456849	1257	1580049
1108	1227664	1158	1340964	1208	1459264	1258	1582564
1109	1229881	1159	1343381	1209	1461681	1259	1585081
1110	1232100	1160	1345600	1210	1464100	1260	1587600
1111	1234321	1161	1347921	1211	1466521	1261	1590221
1112	1236544	1162	1350244	1212	1468944	1262	1592644
1113	1238769	1163	1352569	1213	1471369	1263	1595169
1114	1240969	1164	1354396	1214	1473796	1264	1597706
1115	1242625	1165	1357225	1215	1476225	1265	1600225
1116	1245459	1166	1358556	1216	1478656	1266	1602756
1117	1247689	1167	1361689	1217	1480989	1267	1605289
1118	1249924	1168	1364124	1218	1483924	1268	1607824
1119	1252161	1169	1366921	1219	1485961	1269	1609361
1120	1254400	1170	1368900	1220	1488400	1270	1612900
1121	1256641	1171	1371240	1221	1490841	1271	1615441
1122	1258884	1172	1373584	1222	1493244	1272	1617984
1123	1261029	1173	1375929	1223	1495729	1273	1620529
1124	1263376	1174	1378276	1224	1498246	1274	1622076
1125	1265625	1175	1380625	1225	1500125	1275	1625625
1126	1267876	1176	1382979	1226	1503076	1276	1628176
1127	1270029	1177	1383329	1227	1505029	1277	1630729
1128	1272384	1178	1387284	1228	1507984	1278	1633464
1129	1274641	1179	1390041	1229	1510441	1279	1635841
1130	1276900	1180	1392400	1230	1512900	1280	1638400
1131	1279161	1181	1394761	1231	1515361	1281	1640961
1132	1281434	1182	1397124	1232	1517824	1282	1643524
1133	1283689	1183	1399489	1233	1520289	1283	1645989
1134	1285956	1184	1401156	1234	1522656	1284	1645656
1135	1288225	1185	1404225	1235	1525225	1285	1651225
1136	1287496	1186	1406606	1236	1527696	1286	1653796
1137	1292769	1187	1408904	1237	1530169	1287	1656369
1138	1294994	1188	1411124	1238	1534224	1288	1658944
1139	1297321	1189	1413711	1239	1535121	1289	1661521
1140	1299640	1190	1416100	1240	1537600	1290	1664100
1141	1301881	1191	1418481	1241	1540081	1291	1666681
1142	1304164	1192	1420864	1242	1542564	1292	1669264
1143	1306449	1193	1423249	1243	1545049	1293	1671849
1144	1308736	1194	1425639	1244	1547536	1294	1674336
1145	1311025	1195	1428025	1245	1550025	1295	1677025
1146	1313316	1196	1430416	1246	1552516	1296	1679616
1147	1315509	1197	1432809	1247	1555009	1297	1682209
1148	1317904	1198	1435204	1248	1557504	1298	1683804
1149	1320201	1199	1437601	1249	1560001	1299	1687401
1150	1322500	1200	1440000	1250	1562500	1300	1690000

CHAP. VIII.

How to extract the Square Root, and compose the foregoing Table of Squares.

KNOW then, that a Square Number hath its Sides equal every way, as are the Sides of 4 represented by : : Pricks. And you see that every way of all the 4 Sides containeth 2, and so 2 times 2, make 4, which is the squaring of a Number; so you see 9 Pricks is a Square, or 9 is a square Number, whose Side is 3; and 3 times 3 make 9, but 2 times 3 is not a square Number, as you see : : :, being but 2 one way, and the other way 3, that makes but 6, so then all the Numbers between 4 and 9, are not square Numbers: By the like Reason, a Square made of the next square Number 4 is 16; for 4 times 4 is 16, as by the Pricks you may see it represented here, every of the 4 Sides containing 4, make a square Number of 16, and all the Numbers that are between 9 and 16, as 2 times 4, or 3 times 4, are not Squares, but have a Fraction annexed to them; so also any Number between 16 and 25, are not Squares, as 4 times 5, or 2 times 5, or three times 5; these are not square Numbers; but 5 times 5 is a square Number, and maketh 25; where note, that to square a Number, and to extract the square Root, is two different Things; for when we say, to square a Number, it is to multiply it in itself, or by itself; or when we say, or speak of a Number squared, it is a Number multiplied into itself; but to extract the square Root, is to find the Side of the Square in a Number given, or the extracted square Root is the square Root found in any given Number.

Thus you may conceive of the Squares of 6, for 6 times 6 makes 36; 7 times 7 is 49; 8 times 8 makes 64; 9 times 9 makes 81; 10 times 10 makes 100: There is all the Squares made of the 9 Figures, expressed by this little Table annexed, as against each Figure is the Square made of them, as 2 times 2 is 4; so is 4 against 2, as you see.

1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100

Now to extract the ſquare Root from greater Numbers, as from 144, proceed thus, write down the Sum given as followeth, and make a Quotient on the Right-hand, as you ſee, and ſet Pricks under every other Figure, beginning at the Right-hand, and ſet Pricks towards the Left-hand, under every other Figure, ſo in this Number 144, conſiſting of three Figures, there is two Pricks, and ſo many Figures muſt the Quotient conſiſt of; then begin at the Left-hand of the Sum, and ſay, or enquire for the greateſt Square in the Figure or Figures, over the firſt Prick, at the Left-hand, which, here, is but 1, therefore you can take but 1, for 1 is always the Square, or Cube of 1; therefore write 1 in the Quotient, and ſubtract that 1 from the 1 over the Left-hand Prick, and cancel it, nothing remaining, write a Cypher over it, as you ſee, ſo you have one Figure of the Quotient, then double your Figure found in the Quotient, as 2 times 1 is 2; write that 2 under the Figure between the next Pricks, which is the Diviſor for the ſecond Figure; then ſay, how many times 2 can I have in 4, over the Diviſor? I ſay 2, therefore I write 2 in the Quotient, ſaying, 2 times 2 is 4, which ſubtract from the 4 over-head, cancel the Diviſor, and the 4 over-head, and write a Cypher over it, then ſquare the laſt Figure found in the Quotient, ſaying 2 times 2 is 4, which ſubtract from the 4 over the Prick, and ſo reſteth 0, therefore cancel the 4, and write Cyphers over-head, ſignifying that the Number given to find the Root of, is a juſt ſquare Number, the Root or Side is 12; the Proof hereof is by Multiplication of the Quotient in itſelf, as 12 by 12 makes 144, which if it be the ſame with the Sum given to be extracted, it is rightly done; if it do not agree, it is not true.

144 (
· ·

0
144 (1
· ·

000
1442
·2·

Example of another Sum.

Let 625 be given to find the ſquare Root of it; write down the Sum, make a Quotient, and ſet Pricks under every other Figure; then enquire for the greateſt Square in the Figure, over the Prick, at the Left-hand; I ſay 2 is the greateſt Square can be taken, for 3 times 3 is 9, and here the Figure is but 6; ſo I write 2 in the Quotient, and ſquare it, ſaying, 2 times 2 is 4, taken from 6, ſo reſteth 2; I cancel the 6, and write 2 over it, as you ſee, then double the Figure in the Quotient, ſaying 2 times 2 is 4; this 4 is

2
625 (2
· ·

2
625 (2
·4·

the ſecond Diviſor, I write it between the two next Pricks, and ſay how many times 4 can I have in 22? and I find 5 times; for 5 times 4 is 20, taken from 22, the Figures over 4, ſo reſteth 2; therefore I write 5 in the Quotient, and ſaying, 5 times 4 make 20; therefore I cancel the 4 Diviſor, and the 22, and write 2 over head, then ſquare the laſt Figure found, 5 by 5 make 25, taken from 25 over head, reſteth nothing, ſo the Number given is a ſquare Number.

22
4 25 (25
·4·

22
625 (25
·4·

A Sum of 5476 given, to find the neareſt ſquare Root in it, write down the Sum, and make a Quotient and prick underneath, as afore ſhewed; ſay, What is the greateſt Square in the Figure over the Left-hand Prick? and I find it to be 7, for 7 times 7 make 49, but 8 times 8 make 64, 10 too much, therefore I write 7 in the Quotient, and take 7 times 7, that is, 49 from 54, ſo reſteth 5, which I write over the Prick, and cancel the 5 and the 4; then I double the Figure in the Quotient, which maketh 14 for the Diviſor; I write the firſt Figure of the Diviſor, if there be more than 1 under the Figure, between the two next Pricks, and all the other Figures in their Places towards the Left-hand; then enquire how many times can 1 be taken from 5, over head, and I find it may be taken four times; I write therefore 4 in the Quotient, and ſay, 4 times 1 is 4, from 5, ſo reſteth 1: I cancel the 1 and 5, and write 1 over the 5, then I ſay, 4 times 4 make 16, from 17 reſteth 1: I cancel the 4 Diviſor, and write 1 over 7, and cancel the other 1 and the 7; then I ſquare the laſt Figure found, for ſo it muſt be at every Prick, 4 times 4 make 16, which I ſubtract from the 16 over the laſt Prick, and ſo I ſee nothing remaineth: That ſheweth the Sum given to be a juſt ſquare Sum.

5
5476 (7
··

1
51
5476 (74
··
14

0
510
5476 (74
· ·
14

Example of another Sum.

As if 528563 be given to find the greateſt ſide of the Square therein, I write down the Sum as followeth, and make the Quotient, and ſet the Pricks under every other Figure, as you ſee; and ſeeing there is 3 Pricks, it telleth, that there muſt be 3 Figures in the Quotient, then beginning at the Figures, over the Left-hand Prick, I take the greateſt

Square in 52, and I find it 7, for 7 times 7 make 49; therefore I write down 7 in the Quotient, and ſubtract 49 from 52, ſo reſteth 3, therefore cancel the 52, and write 3 over the 2, as you ſee; then double the Quotient 7, it maketh 14, for a new Diviſor, which write down, the firſt Figure thereof under the Figure between the two next Pricks, namely, 4 under 8, and the other Figure of the Diviſor one place further to the Left-hand, under the 3, as you ſee; then take the Diviſor 1, as many times as you can, from the Figure 3 over head, ſo as that after the Diviſion be made, there may be the Square of the laſt Figure of the Quotient, taken from the Figures over the next Prick, as I can take 1 but 2 times from 2; therefore I write 2 in the Quotient, and cancel the Diviſor 1, ſaying, 2 times 1 is 2, from 3, ſo reſteth 1: I cancel the Figure 3 alſo, and write 1 over head, as you ſee: Then 2 times 4 is 8, from 8 over head reſteth nothing; therefore I cancel the ſecond Figure of the Diviſor, 4 and 8, and write a Cypher over 8, as you ſee; then the next place being a Prick, I muſt ſquare the laſt Figure found, ſaying, 2 times 2 make 4, from 5; the Figure over the Prick reſteth 1, as you ſee; therefore I cancel the 5, and write 1 over it, as you ſee, and here is a Fraction of 101.

3
528563 (7
· · ·
3
528563 (7
· · ·
14
1
30
528563 (72
· · ·
14
1
301
528563
· · ·
14

Then for a new Diviſor, double the Quotient 72, and it makes 144, which is a new Diviſor, the firſt Figure thereof write under the Figure between the next Pricks, as the firſt 4 under 6 in the Sum; and the other Figures toward the Left-hand, in the Order as you ſee: Then how many times 1 in 10 over head, and I ſee I cannot take 8 times, for that there will not be left to take out the other Figures from, nor for the Square of the laſt Figure, which if were 8 would be 64 from the Figure over the Prick, therefore I take but 7, for, by a light Examination, I ſee that will do, therefore I write down 7 in the Quotient, and proceed to the Diviſion thus, 7 times 1 is 7, from 10 over head remaineth 3, which I write down, and cancel the 10, as you ſee; then 7 times 4 is 28, from 31 over head, ſo remaineth 3, which I alſo write down, and cancel the 31; then again 7 times

1
301
528563 (727
· · ·
144
14
131
301
528563 (727
· · ·
144
14

4,

4, the other Figure of the Diviſor, is alſo 28, which taken from 36 over head, reſteth 8, which I write down over 6, and ſo cancel the 36, and then the Sum ſtandeth as you ſee.

Then, laſtly, ſquare the laſt Figure of the Quotient, 7 times 7 make 49, taken from 83, the Figures over the Prick, reſteth 34, as a Fraction, and the Sum is finiſhed: But in regard here is a Fraction, by that it tells you that the Sum given was no ſquare Number; and the greateſt Square therein is 727: the Proof is by Multiplication adding in the Fraction thus, 727 multiplied by 727, make 528529, then adding the Fraction of 34 maketh it 528563, the juſt Sum given.

But ſome may object, and ſay, that this is a very tedious way of Work, and will take up a great deal of Time: It is true, it is more Labour than Demonſtration, but the Truth of it might very well plead for Patience to work it; but it is not neceſſary you perform all the Parts by it, that is in every Particular as the exact hanging of the Wail at every Timber, but it may ſuffice at every third or fourth Timber, to find the hanging of the Wails, only the Riſings alow, afore and abaft, I would work to every Timber there.

```
133
3ø1
528563 (727
 . . .
144
14

333
3ø28
528563 (727
 . . .
144
14

133 (3
33ø18 (4
528563 (727
 . . .
144
14
```

But to make it more brief, in the foregoing Table of Squares, the Numbers are contrived to the ſame purpoſe, to avoid the tedious Extraction of the Root, and only uſe Addition and Subtraction, being but a very little Difference between the finding the Riſings by this Table, and by the *Draught*; for in this kind of *Arithmetical* Work, it matter-eth not, whether there be any *Draught* drawn at all, or no, if the Builder only note in his Book the length by the Keel, and the breadth at the Beam, the Rake of the Stem, Rake of the Poſt, depth of the Water to ſail in, depth of the Hold, height of the Wails abaft, afore at the Mid-ſhips, and all the remarkable Things to be noted, he may be able to build a Veſſel, and never draw a *Draught* at all, and yet affirm his Work to be abſolutely true according to Art, and a great deal more exact than by *Draught*. The Uſe of the Table follows.

CHAP. IX.

The Description and Use of the Table of SQUARES.

TO save the Practitioner the Labour of extracting Roots, for here they are ready done to thy Hand on purpose, and all the Use of *Arithmetick* required is only Subtraction, as *Example* in the Figure of the Sweep foregoing, being 203 Inches, as you saw it found before, which is, I say, always one side of the Triangle, made of the Side *D I*, then knowing the length of *O I*, 132 Inches, which is the distance of the Point, of which the Risings is sought at; seek in the Tables, under the Title of *Inches*, at the head of the Tables, for 132, you will find it in the first Page, and in the third Column towards the Left-hand, and the twenty-second Line; and right-against it, in the same Line under the next Title of *Squares*, you have 17424, the Square made of 132, which subtract from the Square made of 203, which is 41209, which is found in the second Page of the Tables, in the sixth Column, and the third Line: So resteth 23785; seek the Number neerest to it in the Table, under the Title of *Square*, which you will find in the second Page, fourth Line, you find not just the same Number, for instead of 23785, you find 23716, too little by 59, and the Root answering thereto in the same Line, under the Title of *Inches*, towards the Left-hand, is 154; now if you take the next Square lower to the Left-hand, fifth Line, it is 24025, 250 too much, so you may see it is nearer to the fourth Line, because there it was too little but by 59, and it will be $\frac{1}{4}$ of an Inch less than the Number of Inches belonging to the fifth Line, and about $\frac{1}{4}$ of an Inch more than the Numbers in the fourth Line: So that you see it is answered, the third Side *D O* is 154, and $\frac{1}{4}$ of an Inch, which subtracted from the whole Sweep 203, leaveth 48 $\frac{1}{4}$ Inches for the Rising, so you have no need of Extraction of the Roots by these Tables, it is already done to your hand. The Column that is between the *Inches* and the *Squares*, and written *Feet*, *Inches* in the Head, is to shew you how many Feet and Inches of the Foot any Number of Inches is; as here the Number 203 Inches sought, and found in the Tables, in the second Page, and third Line, just against it, in the same Line, between that and the *Squares*, is 16——11: Shewing that it is 16 Feet and 11 Inches; or if the Square were given, as 41209, found

at

at the ſecond Page and third Line, and the ſixth Column, you have 16 Feet 11 Inches, and if you ſeek for it in *Inches*, in the fourth Column and ſame Line, you have 203 Inches. Thus it is very ready to reduce Inches into Feet Meaſure, or Feet into Inches.

Another Example.

In the ſame Figure, to find the Riſing at the Point *F*, the Sweep being 203 Inches, as before is ſaid, is always one Side, throughout the whole Work of the ſame Riſing-line whoſe *Square* is 41209, as is found in the ſecond Page, the third Line; the other ſide from the Point *AF*, is 9 Feet, or 108 Inches, whoſe *Square* is 11664, found in the firſt Page and the twenty-eighth Line; now ſubtract the Square made of the ſide *AF*, 11664, from the Square of the ſide *DE*, ſo remaineth 29545.

	41209
	11664
	29545

Seek in the Table of *Squares* for that Number, and I find in the ſecond Page, and twenty-ſecond Line, the third Column, 29584, the neareſt Number to it, yet it is a little to much, near the $\frac{1}{4}$ of an Inch; and toward the Left-hand in the ſame Line, the next Column under the Title *Feet*, *Inches*, you find 14 4, ſignifying that to be 14 Feet 4 Inches: And in one Column more to the Left-hand, and the ſame Line, you ſee under the Title of *Inches* 172, over the Head you titled *Inches*, which muſt be ſubtracted from 203 Inches, ſo remaineth 31 Inches for the Riſing of *FE*, which is 2 Foot 7 Inches, as in the firſt Page of the Table, and in the thirty-firſt Line.

	203
	172
	031

Theſe few *Examples*, I think, may be ſufficient to ſhew the Uſe of the foregoing Tables of the Squares, the Benefit whereof may be very great, for ſuch as ſhall make uſe of the ſame. If any deſire the finding of the Fractions of theſe Squares, when he findeth not his juſt Figures in the *Squares*, let him do thus, ſubtract the Figures under his Number from the Figures above his Number, the Remainder ſhall be the Denominator; then from theſe Figures given, ſubtract the Remainder from the next *Squares* leſs, the Remainder ſhall be the Numerator to that Fraction.

As for *Example*; in the foregoing Figures, after Subtraction, there remains 29545; the neareſt agreeing in the Tables, is 29584; the next leſſer ſquare Number in the Table is 29241, which is more a great deal too little, than the other is too great; then ſubtract the leſſer ſquare Number 29241, from 29584, and ſo reſteth 343, which muſt be the Denominator,

nominator; then again from the true Number given 29545 ſubtract the next leſſer ſquare Number in the Table 29241, and ſo there reſteth after Subtraction 304, which is the Numerator to the Fraction, and muſt be thus written $\frac{1}{3}\frac{2}{4}\frac{4}{3}$: So then the Number belonging to 29584, is 171 Inches, and $\frac{2}{3}\frac{4}{3}$ parts of one Inch, which being abbreviated, is ſomething more than $\frac{1}{4}$ of an Inch, and not full $\frac{7}{8}$ of one Inch.

29584	
29241	
343	

Thus, he that pleaſeth, may find the riſing of any Timber, or narrowing of any Place by theſe Tables and the help of Subtraction, exactly to any Circle whatſoever; but it may ſuffice, that a Man, going to his Tables, may ſee which *Square* his Figures have greateſt Affinity with, and may eſtimate the Difference near enough, without ſeeking for the Fraction, which will eaſily be known by Practice.

CHAP. X.

Shewing how to hang a Riſing-line by ſeveral Sweeps, to make it rounder aftward, than at the beginning of the ſame.

IF any be deſirous to have a Riſing-line rounder aftward than it is at the fore-part of it, they muſt proceed thus: Firſt, work by the Sweep that they would have firſt, then begin again, and find the other Sweep that they would have the roundeſt: An *Example* of this will make it more plain, as in the following Figure will appear.

Let *D E* repreſent the length of a Riſing-line *E I*, the height thereof 8 Feet on the after-end thereof: Firſt, I find the Sweep that ſweepeth it, by multiplying 20 Feet the length, which is 240 Inches: For if you look in the Tables, under the Title of *Feet Inches*, for 20 Feet, you will ſee in the next Column toward the Left-hand, 240, over head is written *Inches*, ſignifying, that in 20 Feet is 240 Inches, and juſt againſt it, and in the ſame Line, towards the Right-hand, under the Title of *Squares*, you will ſee written 57600, ſignifying, that the Square of 240 is 57600, theſe Numbers you will find in the ſecond Page of the Tables, and the fortieth Line, the fourth, fifth and ſixth Columns.

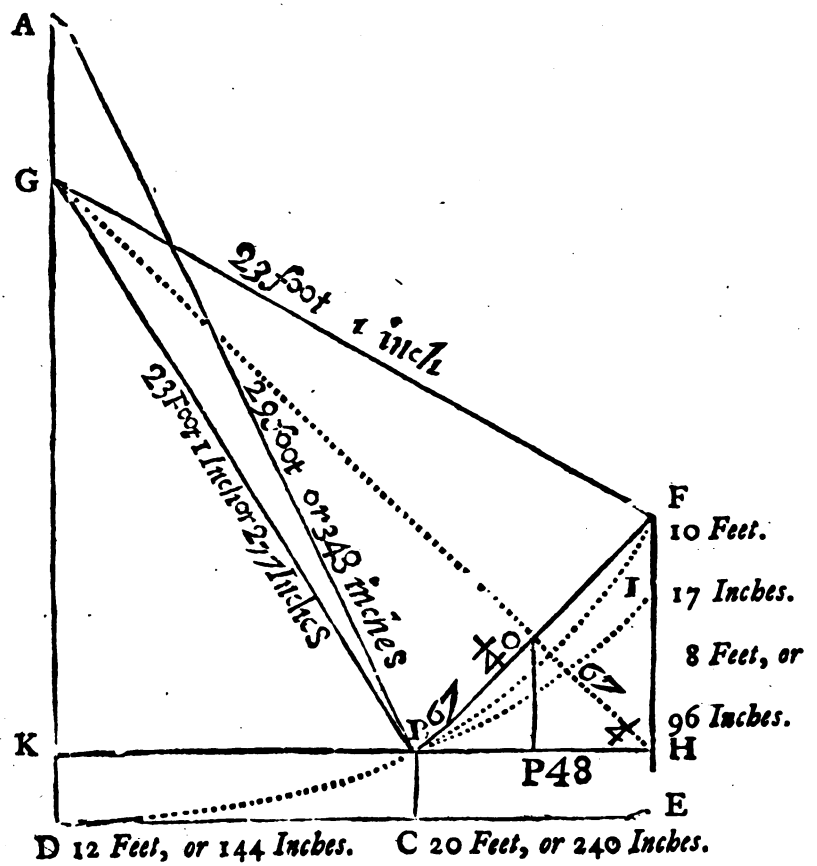
This

This squared Number 57600, made by the Multiplication of *D E* 240 Inches, must be divided by the height of the Rising-line assigned *E I* 8 Feet, or 96 Inches, so remaineth in the Quotient 600, to which must be added the height of the Rising, as is afore taught, and they make 696, which is the Diameter of the whole Circle; the half thereof is 348 Inches, which is 29 Feet, as you may see by dividing it by 12; or else, if you turn to the Tables, and seek under the Title of *Inches* for 348, you will see in the same Line, toward the Left-hand, 29 Feet, which you will find in the third Page, and the forty-eighth Line, the first and second Column; then I work by that Sweep to $\frac{1}{8}$ of the length of the Rising-line, or 12 Feet of the same; at the Point *C* it is represented, at which Point I seek the Rising *C B*, I also seek in the Tables for the *Square* made of 144, and I find in the first Page, forty-fourth Line, at the seventh Column, and towards the Right-hand under the Title of *Squares*, 20736, which is the Square made of 144: Then I seek for the *Square* made of the Sweep, or the Side *A B*, 348 *Inches*, and I find it in the Tables to be 121104, from this 121104 I subtract the other *Square*, made of the Side *D C* 144, being 20736, and there remaineth 100368, whose Root I find in the Tables, in the third Page, and the seventeenth Line, and the third Column, 100489, which is too much by near 121; but the other Number afore it, being much more too little, the Number answering hereunto is 316 *Inches*, and near $\frac{1}{4}$, which subtracted from 348, the whole Side leaveth 31 Inches $\frac{1}{4}$, or 2 Feet 7 Inches $\frac{1}{4}$ for the Rising at the Point *C*: Now to make a rounder Sweep afward, or at the other end of the Line, as from *B* to *P*, which runneth higher up, or roundeth more from *I* to *F*; here will be something more of Trouble to find the Sweep that will exactly touch the two Points assigned, as *B* and *F*. Now the way will be thus:

0	
30	
57600	(600
9566	
99	
121104	
20736	
100368	

Let *B* and *F* be the two Points to which the Sweep is confined to touch; draw a strait Line from *B* to *F*, and so you have a right-angle Triangle made of the Sides *B H*, the length of the Line to be swept by the second Sweep; and the Side *H F*, the height of the same; together with the subtending Side *B F*: Then a Line drawn from the middle of the Side *B F*, perpendicular or square, to the same Line *B F*, and extended till it touch the Side *D A*, the Place where it toucheth shall be the Center of the same Sweep: As is the Line *G H*, passing through the middle of the Side *B F*, at the Point *O*. Which to find arithmetically, proceed

proceed thus: Find firſt the length of the Side *B F*, as is before taught, having two Sides of a right-angled Triangle given, to find the third Side, which will be 134 $\frac{1}{8}$ Inches; the half is 67 Inches $\frac{1}{4}$ from *B* to *O*; then if a Perpendicular be let fall from *O* to the Line *B H*, it will cut that Baſe-line *B H* alſo in halves, in the Point *P*, making *B P* equal to *P H*, and each 48 Inches. Then again, the Side *O H* will be (in this Example) equal to the Side *B O*, but in other Caſes it may not ſo fall out: So then theſe two Sides being known, *O H*, 67 $\frac{1}{4}$ Inches, and *P H* 48 Inches, with the Side *K H*, 240 Inches; you may find *G H* by the *Rule of Three*, ſaying, if *P H* 48 give *O H* 67 $\frac{1}{4}$ Inches, what will *K H* 240 Inches give.



240

If 48 give 67 ½, what will 240?

240
67
1680
1440
16080

2
144
480
8080 (335
888
44

If you multiply the two last Numbers together, and divide by the first Number, you will have in the Quotient 335, for the Side *G H*.

I here neglected the ½ Inch in this Multiplication, for the ½ Inch should have been multiplied into the 240, by adding to 16080, 120, the half of 240, and it maketh 16200, which divided by 48, maketh 337 ½ Inches for *G H*; so then these two Sides *K H* 240, and *G H* 337 ½ being found, find the Side *G K* thus; look in the Table of *Squares* for the *Square* made of *G H* 337, and it will be 113569, from which subtract the *Square* of *K H* 240, being 57600, there resteth 55969, that Number sought for in the Tables, and the neareſt Number to it, is 56069, and the Root of it 237 is the Side *G K*, to which add the Rising *C B*, or *K D*, that is 31 ¼ Inches added to 237, maketh 268 ¼ Inches, or 22 Feet 4 Inches; shewing, that at 22 Feet 4 Inches, from the Point *D*, towards *G*, will be the Point where the Center of the rounder Circle ought to stand: Then again, you have *G K* 237, and *K B* 144, to find *GB*, being the longer Side, you must add the Squares made of the other two Sides together, and the Square Root of those two Sums shall be the longest Side *G B*, that is, the Square of *G K* 237 is 56069, and the Square of *K B* 144 is 20736; these being added together is 76805, whose Square Root neareſt is 277 Inches, or 23 Feet 1 Inch for *G B* the second Sweep. The same Order you may observe to round your Sweep, as often as you please.

113569	
57600	
55969	
237	
31 ¼	
268 ¼	
56069	
20736	
76805	

Note, That when you seek for any Number in the Tables, take heed that you mind the Number of Figures you seek for, to agree in Number with those that direct you to seek for them.

As for *Example*; in the other Figures abovementioned, 55969, they are in Number 5, by their Places, as you ſee; then repairing to the Table, I find 559504; but telling the Figures, I ſee they are in Number 6, but ſhould be but 5: Therefore this Number, repreſented in the fifth Page, and the forty-eighth Line, and the laſt Column, is not the Place I ſeek for; then I turn toward the Beginning of the Table, 'till I ſee that the Columns of *Squares* contain but 5 Figures, and there ſeek the neareſt Number agreeing to 55969; and in the ſecond Page, thirty-ſeventh Line, ſixth Column, I find 56069, the neareſt agreeing to it, which is the Place anſwering to the other directory Figures.

Note alſo, That the *Example* of finding the Sweep aforegoing, is laid down by a ſmall Scale of the *Draught*, by which you may try it for your better Directions.

And in that Table you may ſee, that any farther than 70 Feet, being the End of the fifth Column, ſixth Page, I have not mentioned the *Feet* and *Inches* belonging to the Number of *Inches*, but have left it out, as being of little Uſe any farther; becauſe that will reach far enough for the length of any Riſing-line of any Ship whatever. If any be deſirous to convert any of the following Numbers into Inches, he may do it by dividing by 12.

Thus, I think, I have ſpoken enough to the Ingenious, concerning the ſingular Uſe of the Tables, or of this way of working by Segments or Circles.

CHAP. XI.

Concerning Meaſuring of Ships.

MUltiply the length of the Keel into the breadth of the Ship, at the broadeſt Place, taken from Out-ſide to Out-ſide, and the Product of that by the half breadth, this ſecond Product of the Multiplication divide by 94 for King's Tunnage, or 100 for Merchants Tunnage; and according to that Diviſion, the Quotient thereof is ſo many Tuns: As ſuppoſe in the former *Draught*, being in length 60 Feet, and being multiplied by 26, the breadth produce 1200, and 1200 again multi-

60	
20	
1200	
10	
1200	

plied by 10, the half breadth produceth 12000, if you divide by 100 you need do no more than cut off the two laſt Figures toward the Right-hand; which ſhall be the Anſwer, and rendreth the Ship to be 120 Tuns, but if you divide the Sum 12000 by 94, you will have 127 $\frac{2}{3}$ of a Tun very near: But this cannot be the true Ability of the Ship to carry or lift, becauſe two Ships, by this Rule of equal Breadth and Length, ſhall be of equal Burden, notwithſtanding the Fulneſs or Sharpneſs of thoſe Veſſels, which may differ them very much; or one Ship may have more Timber than the other in her Building, and ſo ſhall carry leſs than the other: But the true way of Meaſure muſt be by meaſuring the Body and Bulk of the Ship under Water; for if one Ship be longer in the Floor than another of the ſame breadth and length, ſhe ſhall be more in Burden than the other; as a *Flemiſh* Ship ſhall carry more than a *French* or *Italian* Veſſel of the ſame length and breadth: Therefore, I ſay, the Meaſure of a Ship is known by meaſuring her, as a piece of Timber may be meaſured of the ſame Form, to the draught of the Water aſſigned her, the weight of the ſame Body of the ſame Water that the Ship ſwimmeth in, ſhall be the exact Weight of the Ship, and all Things therein; Loading, Rigging, Victuals, included therein: Then if the Ship be meaſured to her light Mark, as ſhe will ſwim at being launched, the weight of ſo much Water being taken or ſubtracted from the weight of the Water when ſhe is laden, the Reſidue ſhall be the Weight that muſt load her, or her Ability of carrying, called her Burden: By this Means you may know the Weight of the Ship light, and what ſhe will carry to every Foot of Water aſſigned her, which can be done by no general Rules in *Arithmetic*, becauſe of their greater Irregularity, according to the differing Forms of Ships; you may, if you pleaſe, firſt meaſure the Content of the Keel and Poſt, Stem and Rudder, of all that is without the Plank, and under the Water-line, and note it by itſelf; then meaſure the Body of the Ship in the Midſhips, by multiplying of the depth of the Water-line, and the breadth; then you may find the Content of the Want by the circular part of the Ship under Water, being narrowed downward, and ſubtract this from the whole content of the Body found by the depth of the Water-line and breadth of the Ship, and this ſhall be the ſolid content of that part of the Ship, I mean in ſolid foot Meaſure of 1728 Inches to the Foot: Then proceed to the fore-part or the after part of the Ship, and to 3 or 4 Timbers more, find the mean breadth at the narrowing aloft at the Water-line, and allow at the Floor and the mean Depth, and meaſure that piece of the Ship; as I told

you of the middle part of the Ship, and ſo meaſure the whole Ship by pieces, and add them together; and ſo many Feet as it maketh, ſo many Feet of Water ſhall be the Weight of the ſaid Ship; and the Reaſon may be conſidered thus: There is a Ponderoſity in the Water, but there is a greater in the Air; and there is a Ponderoſity of the Water itſelf, but not ſo much as of other Things more ſolid, as in Iron; ſuppoſe a Gun, or an Anchor of Iron, it ſinketh in the Water, but yet it is not ſo heavy in the Water, as in the Air, by the weight of ſo much Water as ſhall make a Body equal to the Solidity of the Gun, or an Anchor, in magnitude; which Weight ſubtracted from the weight of the Iron Body weighed in the Air, and ſo much muſt be the weight of it in the Water.

Again, If a Body be lighter in weight than Water of the ſame Bigneſs, it hath an Ability of lifting in the Water, and can lift or carry ſo much as is that Difference: As a piece of Cork, or Wood of Fir-trees, being lighter than Water, it ſwimmeth on the face of the Water, and refuſeth to be depreſſed, without more Weight added to it.

Thus a Ship, being a concave Body, is made capable of lifting according to the greatneſs or ſmallneſs of this Concavity, reſpect being had to the greatneſs of the Timber put into it, or the Nature of it, all which maketh a Ship ſwim deeper or lighter in the Water.

I have proved by the *Thames* Water, that freſh Water is lighter than ſalt Water; ſo then ſalt Water being heavier than freſh, cauſeth that a Ship ſwimmeth deeper in the freſh Water than in ſalt.

But in the building of all Ships, there is, or ought to be, a juſt Proportion uſed between the Length by the Keel, the Breadth by the Beam, and the Depth in the Hold, as alſo for the Rake fore and aft, *&c.* only with this Conſideration, as to what Uſe or Trade the Ship is intended for; ſome for Burden rather than Sailing, as Colliers, *&c.* and others chiefly for Sailing, as Gallies, and the like: But as gauging or meaſuring a Ship, may properly be ſaid to belong to Ships whoſe Burden is the chief Thing enquired after, and as the Dimenſions of all Ships as to length, breadth, depth in the Hold, rake fore and aft, *&c.* do not bear the ſame Proportion to one another, there ought, in the gauging or meaſuring, to be Regard had to the depth in the Hold, as well as to the length and breadth; and therefore, both by Reaſon and my own Experience, I approve of the following Rule.

How to Gauge a Ship.

It is certain, that if a Ship is gauged by only the Length of the Keel, from the Heel to the Fore-foot, as the length of the Ship, all the Rake fore and aft is left; but to prevent this Error, Ships built for Burden allow $\frac{1}{5}$ of the breadth for the Rake fore and aft, therefore the half of that, which is three tenths of the Breadth, added to the length of the Keel, or subtracted from the whole length of the Ship from Stem to Stern, reduces the Ship to very near a regular Solid, whose three Dimensions being multiplied together (as in other regular Solids) gives the solid Content, which divided by 93, the Quotient is the Tunnage of the Ship so measured.

To illustrate these Rules the better, I shall propose a Ship of the following Dimensions.

	Feet	*Inches*
Length by the Keel	82	00
Whole Length, Rake and all	98	00
Consequently the Rake fore and aft	16	00
Breadth at the Beam	[illegible]	
Depth in the Hold	[illegible]	
Length by the Keel	[illegible]	00
Half Rake fore and aft add	8	00
Sum	90	00

Multiply the Breadth in Feet in Decimals — 26·5
By the Length — 90

Product — 2385
Multiply by the depth in Feet — 12

Divide (always) by — 93) 28620 (307
720

69

The Burden is 307 Tuns and $\frac{69}{93}$ or $\frac{23}{31}$, or about three Quarters of a Tun.

A

As to the Tunnage of Colliers Ships, it is allowed that every Keel of Coals is 20 Tun, and therefore a Ship of 400 Tuns Burden will carry 20 Keels of Coals, (ſpeaking of the Keels of *Newcaſtle*) and every Keel at *Newcaſtle* makes out 16 Chaldron at *London*. And as the Ships of Burden in the Coal-Trade reckon by Scores of Chaldrons, a Ship of 400 Tun, or 20 Keels of Coals, makes out 16 Score (as the *Billingſgate* Phraſe is) or 320 Chaldron of Coals.

It would ſeem that if we take firſt the ſolid Concavity of a Ship (if the Term may be allowed) and then take the Solidity of a Chaldron of Coals, both in Feet, Inches, or any other known Meaſure, the former divided by the latter, the Quotient would be the Chaldrons that that Ship would contain; and in this Caſe my Curioſity has led me to the following exact Calculation, both as to the Coal-buſhel and the Coal-fatt, which is a quarter of a Chaldron; which Experiment I made aboard of a Collier, when unloading in the Pool, and found the Dimenſions of a Coal-Buſhel and Fatt, and conſequently the ſolid Content of a Chaldron of Coals, as follows:

	Inches
Mean Diameter of the Coal Buſhel	19 . 5
Height of the Cone, or Heap above the top	7 . 7
Cubical Inches in the Heap	766 . 8
Cubical Inches in the Buſhel within	2326 . 5
In all	3093 . 3
Multiplied by 36, the Buſhels in a Chaldron	36
Gives Inches in a Coal Chaldron	111358 . 8

Which divided by 1728 is Cubical Feet 64, and 767 Inches.

But meaſuring alſo a Coal Fatt, of which four makes a Chaldron, I found aboard of a Collier when unloading, as above, the Dimenſions and Content of a Fatt of Coals, as follows:

Mean

	Inches
Mean Diameter in Inches and Decimals	44 . 0
Depth	12 . 3
Height of the Heap	18 . 0
Content of the Conical Heap	9126 . 0
Content of the Fatt within	18710 .
In all	27836
Which multiplied by 4, the Fatts in a Chaldron	4
The Product is the Cubical Inches in a Chaldron of Coals, *viz.*	111344

Which divided by 1728, gives 64 Feet, and 752 Inches, differing but 15 Cubical Inches, from the former.

But this one thing is to be ſaid, That altho' the Buſhel and the Coal Fatt do ſo nearly agree, yet this Rule is not to be depended upon in large Ships; for where there is a great Bulk of Coals, as in a Ship of three or four Hundred Tun, the Weight of the uppermoſt preſſeth the undermoſt ſo cloſe, that as far as I could eſtimate in a Ship of above twenty Keels of Coals, which makes about ſixteen Score at *London*, the loweſt Coals are ſo preſſed by the uppermoſt, that a Chaldron, or 64 Feet, poured into the Ship, will not contain above 54 Feet, or little more, when ſo preſſed together.

AN

ESSAY

For Proportioning the

RIGGING.

THE Center of the Masts Places is general in all 3 Masts Ships. Wherefore having laid down two Figures of Ships by direct Dimensions, and fitted a Scale for them, the Centers of the Masts for all other Ships may from thence be found. For as the Proportion of any Ship's Length is to these, so are the Centers of the Masts Place one to another, and may be set off from the Stem or Stem-post upon either the Gun-deck, or deep Load Mark-line.

Having described the Place of each Mast's standing, I shall, in the next Place, shew how the Length and Bigness of every Mast is found, tho' from a Custom so very different, that 'tis almost impossible to make it general.

MAINMAST.

The Main-mast is the first Mover, whose Proportion is always found from some Part of the Ship, either Length, Breadth, Depth, or Bulk of the Body, and from thence the Dimensions of all the other Masts and Yards are taken.

But to shew a little the different Methods made use of in this matter; some will have it, that the Breadth and Depth of the Ship being added together, and multiplied by 3, and divided by 5, will give the Length of the Main-mast in Yards. Others again will take in the Length of the Keel for a Member to find the Proportion of this Mast; which cannot be methodical, since two Ships may be of equal Length upwards, or equal in Bulk, and their Keels differ 10 Feet.

Now

Now 'tis my Opinion, that the Length at the Lower Gun-deck ought to be one principal Part in this caſe, becauſe it is to be very near the Place of Bearing, and where the Body is divided between two Elements. 'Tis alſo near the Place where the Sails are managed; for the Yards, if not the Maſt, ought to be longer or ſhorter, according to the Ship's Length at that Seat. The extreme Breadth of the Ship ought to be another Part, ſince the broader any Ship is, the more ſhe will reſiſt the Medium, and the more Sail will be requiſite to drive her. The Depth ſhould alſo be taken in, being almoſt of the ſame Nature as the Breadth.

To apply this therefore, I take the Length of the Gun-deck, the main Breadth, and Depth in Hold, and add them together, and take the Half for the Length of the Main-maſt in Feet, only ſubtracting the Depth of the Main-ſtep out of the Depth in Hold, which Depth of the Main-ſtep I allow to be $\frac{1}{6}$ of the Depth in Hold, *viz.*

	Feet. In.
Length on the Lower Gun-deck from the Inſide of the Rabbets	150 : 0
Breadth from the Outſide of the Plank	40 : 0
Depth in Hold 16 : 0, Take out 2 *Feet*, 8 *In.* remains	13 : 4

F. I. 2 : 8

6)16(2-8 — 4(— 13 : 4

Feet. In.

3)101-8(33 : 10⅔ — 12(— 203 : 4 | 101 : 8

Length of this Ship's Main-maſt in Yards is 33 Yards, 10 Inches ⅔.

The Length of the Main-maſt being conſidered, the next Thing requiſite, is to make her Diameter in the biggeſt Place ſuitable to it, or the Streſs it will bear. Which Proportion is alſo various, not only from the Bulk and Uneaſineſs of the Ship, but alſo from the Difference there is in the Strength of the Timber, and Nature of the Soil from which it is produced.

Let us ſuppoſe then three ſorts of Trees, one of *Riga*, another of *Gottenburgh*, and a third of *New England*. A Maſt of 9 Inches Diameter, of *Gottenburgh* Growth, would be equal to one of 10 Inches and half of *Riga* Growth, and thoſe two of ſuch a Bigneſs will be equal to a *New England* Tree of 12 Inches Diameter. Not but that there may be a vaſt Difference between the Trees of each Country's Growth, not only from the Years they have ſtood, but alſo from the Soil where they grew.

It muſt be obſerved, that for every Yard in Length of a Main-maſt for a Ship of the largeſt Size, there is an Inch allowed for the Diameter; for a middle-ſized Ship $\frac{7}{8}$ or $\frac{6}{7}$ of an Inch; and for a ſmall one $\frac{4}{5}$ or $\frac{3}{4}$ of

an Inch. And this is alſo, in ſome meaſure, to be allowed according to the Security the ſaid Maſts have by the Rigging.

FORE-MAST, TOP-MASTS.

The Fore-maſt ought to be $\frac{7}{8}$ or $\frac{8}{9}$ of the Main-maſt, the Fore-top-maſt $\frac{1}{3}$ of the Fore-maſt; and ſo the Main-top-maſt to the Main-maſt.

MAIN-YARD, FORE-YARD, TOP-SAIL-YARDS, *&c.*

The Main-yard is $\frac{7}{8}$ of the Main-maſt, the Fore-yard $\frac{7}{8}$ of the Main-yard, Top-ſail Yards $\frac{1}{9}$ of the Main-yards reſpectively, the Top-gallant Yards $\frac{1}{2}$ the Top-ſail Yards, and the Top-gallant-maſts $\frac{1}{2}$ of the Top-maſts, or ſomething ſhorter.

BOWSPRIT, *&c.*

The Bowſprit ſhould be $\frac{2}{3}$ of the Main-maſt for Length, or $\frac{1}{4}$ of the Fore-maſt for ſmall Ships; and for Bigneſs, let it be $\frac{9}{10}$, or more, of the Main-maſt. The Sprit-ſail Top-maſt is $\frac{1}{3}$ of the Fore-top-maſt for Length, allowing $\frac{1}{4}$ of an Inch in Diameter to every Yard in Length for the ſmalleſt of theſe Maſts or Yards, and not exceeding one Inch for the biggeſt.

MIZON-MAST.

The Mizon-maſt ought to be (in ſuch a Ship as the Figure repreſents) $\frac{6}{7}$ of the Main-maſt, allowing $\frac{2}{3}$ of an Inch Diameter for every Yard in Length. And this Length for the Mizon-maſt is when it ſteps in the Hold, but if upon the Lower Gun-deck, then the $\frac{2}{3}$ of the Main-maſt will be ſufficient. But in a ſmall Ship $\frac{5}{6}$ of the Length of the Main-maſt will do for the Mizon-maſt, if it ſteps in the Hold.

MIZON-TOP-MAST.

The Mizon-top-maſt is $\frac{1}{3}$ of the Mizon-maſt ſtept in Hold, allowing $\frac{1}{4}$ of an Inch for Bigneſs to a Yard in Length.

MIZON-YARD, *&c.*

The Mizon-yard is as long as the Fore-yard, allowing $\frac{1}{2}$ an Inch in Bigneſs for a Yard in Length; Mizon-top-ſail Yard $\frac{1}{3}$ of the Mizon-yard, allowing $\frac{1}{4}$ of an Inch for Bigneſs. The Croſs-jack Yard is ſomething longer than the Main-top-ſail Yard, allowing to every Yard in Length $\frac{1}{2}$ an Inch in Diameter. The Sprit-ſail Yard is $\frac{1}{7}$ of the Fore-yard, and Sprit-ſail Top-ſail Yard $\frac{1}{2}$ the Sprit-ſail Yard.

It

It was the Opinion of a very good Maſt-maker, to take the Length of the Lower-Gun-deck, and the extreme Breadth, and adding them together, to take half that for the Length of the Main-maſt in Feet, *viz.*

Length on the Deck from Rabbet to Rabbet ———	150
Breadth extreme — ——— ——— —	40

$$3\,)\,\frac{190}{95}\,(\ \text{Yds. Ft.}\ 31:2$$

2

This Maſt, according to Cuſtom, is 32 Yards.

Therefore between this Calculation and the aforeſaid, may every three-maſted Ship's Main-maſt be proportioned.

Having briefly deſcribed the Dimenſions of the Maſts and Yards proper for any Ship, I ſhall proceed to ſhew what Rigging is neceſſary to ſecure them, and Engines to perform the Services requiſite to be done on board the Ship, as alſo the Pulleys of a leſſer Denomination to traverſe the Sails, and bend them to the Wind.

In order to this, I might divide the Rigging into three Parts, for a better Explanation of it, but ſhall content myſelf with making two Figures to ſhew every Rope with as much Clearneſs as poſſible; and ſhall alſo ſo interchangeably place the Rigging in each Figure, that what is upon one Maſt, and not upon the other, muſt be ſuppoſed to be wanting on the Maſt to make the Rigging compleatly perfect, which is done, that the Sight of one part of the Rigging may not hinder or embaraſs that of the other.

In the triple Diviſion above-mentioned, the firſt part being the grand Engines, as Pendants of the Tackles, Runners, and Tackle-falls fitted with Blocks and Shivers for facilitating the Purchace, ſerves to regulate many other Parts, as the Yards, Top-maſts, Anchors, Boats, all ſorts of Stores and Proviſions, and alſo to ſet tort the Standing Rigging.

The Second Part is the Stays, Shrowds, and Back-ſtays, the grand Security of the Maſts, for which Reaſon they ought to be, as near as poſſible, placed in a circular Poſition, that the Security may equally affect the Strain.

The Third Part is to the ſmaller Pulleys, made uſe of to trim the Sails to the Wind, which Ropes ought to be placed with as much Advantage to the Purchaſe as poſſible, that the Angle the Rope makes at the Pulley may be as obtuſe as poſſible, and that they may come one clear of another,

ther, and be brought down or conveyed from Pulley to Pulley to the Decks of the Ship, where they may be conveniently haled and faſtened, which is term'd belay'd.

But I ſhall proceed to ſhew in the Figures, how all this may be performed with as much Clearneſs as poſſible.

Figure A.

A. is the Main, Mean, or Middle Maſt.
B. the Fore-maſt.
C. the Bowſprit.
D. the Sprit-ſail Yard.
E. the Sprit-ſail Top-ſail Yard.
F. the Sprit-ſail Top-maſt.
G. the Jack-ſtaff.
H. the Fore-yard.
I. Fore-top-ſail Yard.
K. the Fore-top-maſt.
L. Fore-top-gallant Yard.
M. Fore-top-gallant Maſt.
N. Fore-top-gallant Stump.
O. the Main Yard.
P. the Main-top-ſail Yard.
Q. the Main-top Maſt.
R. Main-top-gallant Yard.
S. Main-top-gallant Maſt.
T. Main-top-gallant Stump.
U. the Mizon Maſt.
W. the Mizon Yard.
X. Croſs-jack Yard.
Y. Mizon-top-ſail Yard.
Z. Mizen-top Maſt.
1. Mizon Flag-ſtaff.
2. the Enſign Staff.

Go towards the Bowſprit.

RIGGING.

3. Sprit-ſail Top-ſail Lifts.
4. Sprit-ſail Truſle-trees and Croſs-trees.
5. Fore-top-gallant Stay.
6. A Crane-line, as a Back ſtay for the Sprit-ſail Top-maſt.
7. the Fore-top-maſt Stay.
8. Sprit-ſail Lifts.
9. Sprit-ſail Braces.
10. A Bob-ſtay to ſteady the Bowſprit againſt the Strain of the Fore-ſtay.
11. the Gammoning of the Bowſprit, being faſtened to the Knee of the Head, and the grand Security the Bow-ſprit hath.
12. the Ship's Cable, as if at an Anchor.
13. the Fore-ſtay.
14. Fore-lifts to keep the Yard horizontal, or directly level each way.
15. the Fore-top-ſail Lifts.
16. Fore-top-gallant Lifts.
17. the Fore-runner, and the ſingle Part above it, is the Pendant of the Fore-runner and Tackle, the firſt Piece of Rigging that is placed over the Maſt.
b i. the Fore-tackle Fall.
18. the Pendant of the Fore-top-maſt Tackle.

g i. the Fore-top-tackle Fall.
f i. the Block.
19. the Main-ſtay.
20. the Guy of the Winding-tackle.
21. the Guy of the Garnet.
22. the Garnet-fall, a Tackle much in uſe, to hoiſt in all the Stores and Proviſions.
23. the Winding Tackle Fall, which is put up on purpoſe to get the Guns in and out.
24. the Main Lifts.
25. Main-top-ſail Lifts. The Top-ſail Lifts are uſed as Top-gallant Sheets.
26. the Main-top-gallant Lifts.
27. the Main-top-maſt Shrowds.
28. the Main Shrowds and the Croſs-lines, called Ratlins, ſerving as Steps to go into the Main-top.
29. the Main Swifter, a Part of the Shrowds, but not ratlin'd.
30. the Mizon Stay.
31. Mizon Top-ſail Sheets.
32. Croſs-jack Lifts.
33. Mizon Top-ſail Lifts.
34. Mizon Top-maſt Stay.
c i. the Boat-rope, made faſt to the Boat to tow her a-ſtern.
d i. the Gueſs-rope, which is alſo made faſt to the Boat to keep her directly in the Wake of the Ship.

Go back to the Main-maſt.

b i. the Lanyards of the Main Shrowds reeved through dead Eyes of Wood, the lower of which are iron-bound, called Chain-plates.
36. the Puttock Shrowds, binding the main Shrowds and Top-maſt Shrowds together.
37. The Main Top.
38. the Main Cap.
39. the Main Truſle-trees and Croſs-trees. Obſerve that every lower Maſt has a Round Top for the Conveniency of furling the Top-ſail, and ſpreading the Shrowds. Alſo the Bow-ſprit in this Size has a Top, and all bigger ſized Ships, but none leſs. Likewiſe all Maſts have Truſle-trees, Croſs-trees, and Caps, being to ſcarph the Maſts one to another.

Go forward to the Fore-maſt.

L. i. the Sheet Anchor.
k. i. the beſt Bower Anchor, hung up with the Shank-painter Chain at one End, and the Cat-block at the other. Which Cat is the part that hales the Anchor out of the Water, when the Capſton can heave it no farther, the Cable being bended to this Anchor, and going into the Hawſe-hole.
41. the Fore Jeers that hoiſt the Yard up.
40. the Sprit-ſail Top-ſail Braces.
35. A Crow-foot at the Mizon Peek, as much for Ornament, as to keep the Mizon Yard at a conſtant Angle.
42. Horſes for the Yards; a Conveniency for Men to tread on, in going out to furl the Sails.
43. The Main and Fore Top-ſail Sheets.

I come now to the ſecond Figure, in which I ſhall ſet down the Running Rigging, without taking notice of the Maſts, Yards, and Standing Rigging, which I ſhall refer to the former Section and Index. Note alſo, that I have not drawn the Yards to their extreme Lengths in this Figure, for the more clearly ſhewing the Sails.

Figure B.

A. is the Fore-ſail. The upper Part is called the Head of the Sail, the Extremes of which are the Ears, made faſt to the Yard with Lines called Ear-rings. The lower Part *c*, is called the Foot of the Sail, the Extremes of which *b*, is called the Clew, where the Sheets and Tacks are made faſt, haled up with Ropes called Garnets.

27. Clew-garnets. Obſerve, that in haling up this Sail, the Clew-lines are the firſt Movers, haling up not only the Weight of the Sail, but the Sheets and Tacks, and Blocks belonging thereto.

a. is the Leech of the Sail, where are Ropes on the other ſide, called Leech-lines, 26.

The Middle Part or Body of the Sail is termed the Bunt, from its ſwelling out, and the Ropes that hale it are called Bunt-lines, 25.

a. i. are the Bow-lines, oppoſite to which are the Braces *b. i.* which two Ropes trim the Sail, and ſet it to the Wind.

29. The Pendants of the Braces.

2. The Fore-ſheets, and 3. the Fore-tacks, which two Ropes ſet the lower part of the Sail, as the Braces do the upper part, and Bow-lines the middle part. This Sail is tack'd down to the Head of the Ship, if there be any; otherwiſe there is a Piece fitted for that purpoſe, as a Prow, by ſome called a Bumpkin.

And this may ſuffice to deſcribe the Sails, ſince the Parts of all Square Sails are called by the ſame Names.

B is the Fore-top-ſail braced back, which is done either in traverſing or tacking the Ship, or otherwiſe to ſtop her way, termed Lying-by.

a. and *b.* are Reeves to take up part of the Sail, as the Wind riſes, and it becomes dangerous either for the Sides of the Ship, or the Maſts to carry the Top-ſail a-trip; and if it ſhould be lowered without being reefed, it will not ſtand ſharp to the Wind, but bag, and be oppoſed to the Motion of the Ship. And ſince theſe Sails taper, and the upper part is no ſquarer than the Top-ſail Yard, and the lower part fitted to the Main-

Main-yards; it ſhould be obſerved in allowing for the Yard-arm, that the Top-ſail Yard be ſo much longer than the general Allowance, as the Difference is between the Length of the Sail at the Head, or upper Part, and the Length at the lower Reef *b*, and that Allowance ſhould be put into the Yard-arm without the Cleats, for the Conveniency of reefing the Sail. Theſe Yard-arms may be without the Cleat, for every Inch the Yard is in Diameter in the middle part, or Slings, 2 Inches in Length.

The lower part of all Top-ſails are ſpread by the Main-yards, there being Blocks provided for that Purpoſe, called Top-ſail ſheet Blocks, 30. the Top-ſail Sheets being reeved there, and brought through another Block near the Slings of the Yard, and ſo handed down to the Decks, where they are reeved through Knight-heads, and ſo haled home, and belayed about the Knight-heads, or Top-ſail-ſheet Bits.

4. Fore-top-ſail Braces.
5. Fore-top-ſail Bow-lines.
31. Fore-top-ſail Bunt-lines.
32. Fore-top-ſail Leech-lines.

It may be alſo obſerved, that the Extremes of every Sail are bound with a Rope called a Bolt-rope.

C. is the Fore-top-gallant Sail. *d.* are the Sheets of the Fore-top-gallant Sail, and Fore-top-ſail Lifts.

This Sail imitates a Signal for ſpying an Enemy, when they ſay the Top-gallant Sheets are flown.

6. the Fore-top-gallant Bow-lines.
7. the Braces.

Obſerve that every Rope is conveyed down to the Deck from one Stay to another, and ſo to the Maſts, and there perpendicularly lower'd, having Conveniencies provided in the Hull of the Ship, both to haul and belay every Rope.

E. is the Main-ſail, neither furled, ſet, nor ſpread; but as 'tis often termed, hauled up in the Brails, in order either to furl or to ſhorten the Sails.

10. Main Braces.
11. Bow-lines.
12. Main-tack.
13. Main Sheets.
33. Main Bunt-lines.
34. Leech-lines.

G. is the Main-top-ſail ſet to the Wind.

8. Main-top Bow-lines.
9. Braces.
36. Bunt-lines.
37. Leech-lines.
45. Clew-lines.

H. Main-top-gallant Sail.
15. Main-top-gallant Braces.
14. D°. Bow-lines.
46. Clew-lines.

I. the Mizon haled up in the Brails.

19. are the Main Brails.

20. the Peek Brails. Obſerve, that the upper End of the Mizon is called the Mizon-peek; and when a Mizon is reefed, 'tis called a Mizon Ballaſt.

10. the Mizon Sheet.

47. Mizon Bow-lines.

48. Mizon Tack.

K. the Mizon-top-ſail, where may be obſerved a Reef, not ſo much out of Neceſſity, as to practiſe Youth.

16. Mizon-top-ſail Braces.

49. Clew-lines.

17. Croſs-jack Braces.

21. Poop Lanthorns to carry Lights.

18. Mizon-top-ſail Bow-lines.

Go to the Main-maſt.

22. The Swifter.

25. A Breaſt Back-ſtay.

35. A Crow-foot to ſave the Top-ſail, when 'tis handed, or taken in.

23. Top-ſail Haul-yard Runner.

24. Haul-yard Fall, or Haul-yard.

Go to the Fore-maſt.

37. The Back-ſtays.

38. A Meſſenger to keep the Top-ſail Haul-yard clear of the Fore-top.

Go to the Bow-ſprit.

D. The Sprit-ſail furled.

L. The Sprit-ſail Top-ſail furled.

The Lines that are drawn croſs the Yards, are called Rope-bands; they make faſt the Sail to the Yard, and Gaſkets furl them.

There are other Sails called Stay-ſails, uſed on almoſt every Stay; as, the Main Stay-ſail, Main-top-maſt Stay-ſail, Fore-top-maſt Stay-ſail, Mizon Stay-ſail, and ſometimes on the Mizon-top-maſt Stay, and Top-gallant Stay. And ſuch Sails are very uſeful, if the Ship goes any thing from the Wind, that is, when the Sails are conſtantly full, and not ſhivering.

There is another Sail called a Flying Gib, a Sail of good Service to draw the Ship forward, but very prejudicial to the Wear of the Ship forward.

'Tis uſed with a Boom, or ſmall Maſt, extended at the Extremes of the Bowſprit.

There are alſo Sails called Steering Sails, made uſe of at the Extremes of the Main Yards and Top-ſail Yards, very beneficial when the Ship goes before the Wind or Quartering, otherwiſe they are uſeleſs.

I am of Opinion, that the Length of the greateſt part of any Ship's Rigging cannot well be expreſſed with more Exactneſs than in the Figures here annexed. And as for thoſe other Parts whoſe proper Lengths do not appear in this ſingle View, as Stays, Shrowds, *&c.* a little Aſſiſt-

ance

ance from able and experienced Boatſwains and Riggers will be able to compleat theſe Figures, and make them univerſal for giving the exact Length of every Piece of Rigging in any Ship. And the Charge of ſuch Figures will be very inconſiderable to the Rope that may be ſaved in making them.

I ſhall now proceed to draw a general Proportion for Rigging any Three Maſt Ship.

A General Proportion for the RIGGING of a THREE-MAST SHIP.

For the BOWSPRIT.

HOrſes Length $\frac{6}{7}$ of the Bowſprit.

Circumference, $\frac{1}{7}$ of the Diameter of D°.

Dead Eyes for D°. twice the Diameter of the Circumference of the Horſe.

Lanyard for D°. Length, $\frac{1}{3}$ of the Horſe. Circumference, $\frac{1}{2}$ the Horſe's.

Straps for D°. equal in Bigneſs to the Horſe, and $\frac{3}{7}$ of the Length.

Gammonings, Circumference, $\frac{1}{5}$ of the Diameter of the Bowſprit, and 6 times its Length.

Wooldings, $\frac{1}{2}$ the Bigneſs of the Gammoning, and $\frac{1}{2}$ of the Length.

Bob-ſtay, $\frac{2}{3}$ of the Length of the Bowſprit.

Sheets for the Sprit-ſail Cabled, Circumference, $\frac{7}{25}$ of the Diameter of the Sprit-ſail Yard.

Length, 7 times as long as that Yard.

Two round Blocks, 4 times the Length of the Circumference of the Sheet.

Pendants Cabled, $\frac{6}{7}$ of the Sheets for Bigneſs, and $\frac{1}{10}$ of the Length.

Hallyards, equal in Bigneſs to the Sheets, and $\frac{1}{2}$ the Length.

Lifts, equal in Bigneſs to the Pendants, and $\frac{2}{3}$ of the Length of the Sheets.

Seizing to the Bowſprit, $\frac{2}{3}$ of the Bigneſs of the Lifts, and $\frac{1}{5}$ of the Length.

Standing Lifts, equal in Bigneſs to the Horſes of the Bowſprit; and alſo in Length.

Lanyards, equal in Bigneſs to the Seizings, and half the Length.

Straps, $\frac{1}{4}$ of the Bigneſs of the Standing Lifts, and $\frac{1}{3}$ of the Length.

Braces, $\frac{1}{6}$ of the Lifts, and half as much longer.

Pendants, $\frac{1}{3}$ bigger than the Braces, and $\frac{1}{10}$ of the Length.

Slings, twice as big in Circumference as the Braces, and $\frac{1}{5}$ of the Length.

Seizing and Rackings, $\frac{3}{10}$ of the Slings, and twice as long.

Horſes for the Yards, Circumference $\frac{3}{20}$ of the Diameter of the Yard, Length $\frac{1}{6}$ of the Yard.

Lanyards, $\frac{1}{3}$ of the Horſes in Bigneſs, and $\frac{1}{6}$ of the Length.

Clew-lines, Circumference, $\frac{1}{21}$ of the Diameter of the Sprit-ſail Yard, and 4 times the Length of the Yard.

Bunt-lines, $\frac{1}{3}$ of the Clew-lines in Bigneſs, and $\frac{1}{3}$ of the Length.

Reef-lines, half the Circumference of the Bunt-lines, and five times the Length of the Yard.

And after ſuch a Method may every individual Part of the Rigging be proportioned and calculated. Tho' I cannot deny but it will be very troubleſome, and therefore I ſhall endeavour to abbreviate it, and make it ſomething eaſier. In the proſecution of which, I ſhall obſerve this Method, only particularly to proportion the material Ropes, and bring all Lanyards, Pendants, Seizings, Straps for Blocks, Ratlings, Wormings, Runners of Tackles, and Tackle-falls, into a general Proportion as to their Bigneſs, ſhewing ſome Reaſons why it ſhould be ſo.

The Uſe of a Lanyard being to unite two other Parts together, as Stays and Shrowds, and ſeveral other Ropes that are very large, and cannot be ſo well joined or knit together, otherwiſe than by the Help of ſmaller Ropes: I have obſerved it to be almoſt general, that the Lanyard is $\frac{1}{4}$ the Circumference of the Ropes they ſecure, ſo that they are $\frac{1}{4}$ as ſtrong; that 4 ſuch Parts are equal to one Part of the great Rope; tho' it is uſual to have 6 Parts applied as Lanyards to every Rope that they ſo ſecure; and yet very often the Lanyard is broke, and very ſeldom the Shrowd; Which muſt certainly be owing to the moving of the Ship, when the Shrowds on one ſide being ſtretched by the Weight of the Maſt, the other ſide gains Length, by which the Lanyards grow ſlack, and by a ſudden Jirk are fretted againſt the Wood in which they are reeved, and ſo broke. For otherwiſe, in a regular Strain, the 6 Parts of the Lanyards of $\frac{1}{4}$ the Circumference of the Rope they ſecure, muſt hold longeſt.

Where-

Wherefore, since 6 Parts of a Lanyard of $\frac{1}{3}$ the Circumference will be sufficient to hold any such Rope, there may be a general Proportion drawn, that where the Size of any Lanyard is required less in Proportion to the Rope they so secure, as in Stays, and several other Ropes, there the Number of Turns will make up the Lanyard equal in Strength to the 6 Parts of those which are half the Circumference of the Rope. And for the Space between, allow for every Inch the Dead Eye is in Diameter, 3 Inches and $\frac{1}{4}$ between each Dead Eye. And this is for Thwart-ships; but Fore and Aft they need not be so much, but in a cubical Proportion between the Length and Breadth of the Ship. For the Property in this Part is no other ways to be considered than from the Motion of the Ship; since the shorter the Space, the better for the Lanyard, but the worse for the Great Rope.

The Seizings may be $\frac{1}{6}$ of the Rope they seize, allowing such a Number of Turns, as may be equal to double the Weight of a Cube or Die-square, made by each respective Rope so seized.

Straps of Blocks are generally in two Parts, and sometimes in four, which ought to be equal in Strength to the Folds of the Tackle-fall, or any other Rope. And since 4 Parts of any Rope of 6 Inches Circumference, are near equal to 2 Parts of a Rope alike in Goodness, of 8 Inches and $\frac{1}{2}$ in Circumference; those two Parts will be suitable for a Strap to a Block that is used with 4 Folds, as a Tackle-fall, or any other running Rope. From whence may arise a general Proportion for strapping every Block in a Ship, as to Bigness; but for the Length, they are practically allowed to be three times the Length of the Block, or something more, it being altogether unreasonable to confine the Workman or Rigger to an Inch of Rope. But it ought to be observed, that such a Length will do, when the Block is only seized with an Eye; for if Blocks are to be put over a Yard, or the like, the Property will be altered.

Pendants; their Circumference may be considered from the preceding Rule of Strapping Blocks; but the Length is various, according to their Use.

Ratlings are $\frac{1}{6}$ of the Shrowds; Wormings $\frac{1}{8}$ of the Rope.

Pendants of the Main and Fore-mast ought to be as big as the Shrowds, since they purchase a great Weight of Boats and Anchors.

The Runners are $\frac{1}{1\frac{1}{2}}$ of the Pendants, and Tackle-falls $\frac{1}{3}$ the Circumference of the Pendants.

But before I proceed any farther, I shall set down a few Abbreviations, to contract a little the remaining Part, observing that all Rope is sized as to its Bigness by the Circumference, which in every Article shall be first mentioned.

Cir. } *signifies* { Circumference.
Di. } { Diameter.
Le. } { Length.
D°. } { The ſame.

For the SPRIT-SAIL TOP-MAST.

SHrowds, Cir. $\frac{2}{5}$ of the Di. of the Sprit-ſail Top-maſt in the Cap. Le. $\frac{2}{3}$ of the Top-maſt's Length.

Pendants of Back-ſtays, or Crane-line, as ſome call it, as big as the Shrowds, and $\frac{1}{5}$ of the Length.

Falls of the Pendants, $\frac{1}{2}$ the Pendant, and 6 times as long.

Tie of the Hallyards, as big as the Shrowds.

Hallyards, $\frac{1}{4}$ of the Tie, and 3 times as long as the Top-maſt. Le. of the Tie $\frac{1}{3}$ of the Hall-yards.

Lifts, as big as the Hall-yards, and twice as long.

Braces, $\frac{2}{3}$ of the Lifts, and twice as long.

Pendants of Braces, as big as the Lifts, and $\frac{1}{10}$ of the Le. of the Brace.

Parrel-rope, as big as the Pendants of the Brace; and for every Inch the Maſt is through in the Cap, allow 2 Feet for the Le. of the Parrel-rope.

Clew-lines, as big as the Lifts, and 5 times as long as the Hallyards.

For the FORE-MAST.

PEndants of the Tackles, Cir. $\frac{2}{7}$ of the Di. of the Fore-maſt in the Partners, and for every Inch in Circumference allow one Fathom for Length.

Runners of the Tackle, $\frac{1}{1}\frac{1}{2}$ of the Pendant, and 4 times the Length.

Tackle-falls, $\frac{1}{2}$ the Pendants, and 9 times the Length.

Shrowds, Cir. as big as the Pendants, and $\frac{8}{11}$ of the Le. of the Fore-maſt.

Lanyards as before, Ratlings D°. Wormings D°.

Cat-harping Legs and Falls equal in Bigneſs, being $\frac{1}{4}$ of the Shrowds. Le. twice that of the Fore-yard.

Fore-ſtays, Cir. $\frac{1}{2}$ the Di. of the Fore-maſt, and $\frac{8}{9}$ of the Length.

Lanyard $\frac{7}{20}$ of the Stay, by reaſon this Lanyard's Strength is made up by the Number of Turns extraordinary.

It may alſo be obſerved, that the Le. of the Lanyard for the Stay, to the Le. of each Lanyard for the Shrowd is as 2 to 1.

Worming as aforeſaid.

Collar of the Stay, $\frac{2}{10}$ in Bigneſs to the Stay, and $\frac{1}{4}$ of the Length.

Woolding of the Maſt, for every Inch the Maſt is in Di. at the Partners allow $\frac{2}{8}$ for the Cir. of the Woolding; and for the Le. allow 8 times the Le. of the Maſt.

Crow-feet for the Top, as big as the Ratling, and as long as the Cat-harpings. Tackle for D°. equal in Bigneſs, and $\frac{1}{7}$ of the Length.

Jeers, $\frac{1}{6}$ of the Shrowds, and 6 times the Le. of the Yard.

Laſhers for the Yards, as big as the Lanyards of the Shrowds, and twice as long as the Stay.

Tackles for Boats, as big as the Woolding, and $\frac{1}{2}$ as long as the Falls of the Runner.

Lifts, $\frac{1}{2}$ the Shrowds for Bigneſs, and 4 times as long as the Fore-maſt.

Straps for the Cap, as big as the Lifts, and as long as the Collar of the Stay.

Braces, as big as the Lifts, and as long within $\frac{2}{5}$ Parts.

Pendants as big as the Braces, and $\frac{1}{10}$ as long; which may be a general Rule for the Length of the Pendants of the Braces.

Parrel-ropes, Cir. $\frac{1}{6}$ of the Di. of the Maſt in the Partners. And for every Inch the Maſt is there, allow 3 Feet for Length.

Nave-line, as big as the Cat-harpings, and as long.

Racking and Seizing for the Parrel, $\frac{2}{3}$ of the Nave-line, and $\frac{4}{5}$ of the Length.

Horſes for the Yard worn Rope, $\frac{9}{10}$ of the Jeers for Bigneſs, and $\frac{10}{11}$ of the Yard for Length.

Lanyards, $\frac{2}{3}$ as big, and half as long.

Puddening for the Yard, as big as the Jeers, and 12 Cir. of the Yard in the Slings.

Fore-ſheets, as big as the Jeers, and 5 times the Length of the Fore-maſt.

Stoppers, as big as the Fore-ſheets, and $\frac{1}{2}$ of the Length.

Lanyards, as big as the Worming of the Shrowds, and $\frac{2}{3}$ of the Length of the Stoppers.

Fore-tacks, as big as the Sheets, but taper'd, and $\frac{1}{2}$ as long.

Bow-lines, as big as the Braces, and $\frac{1}{8}$ of the Length.

Laſhers, $\frac{1}{6}$ of the Bow-lines, and $\frac{1}{7}$ of the Length.

Bow-line Bridles, as big as the Bow-lines, and $\frac{1}{10}$ of the Le.

Clew-garnets, as big as the Braces, and as long.

Bunt-

Bunt-lines, $\frac{2}{3}$ of the Clew-garnets, and as long as the Jeers.

Leech-lines, as big as the Bunt-lines, and half as long.

Reef-lines, $\frac{1}{2}$ the Leech-lines, and 4 times the Le. of the Yard.

Rope-bands and Ear-rings, $\frac{1}{2}$ of the Leech-lines, and 7 times as long as the Yard.

For the FORE TOP-MAST.

SHrowds, Cir. $\frac{1}{3}$ of the Di. of the Top-maſt, and $\frac{1}{1}\frac{1}{4}$ of the Length.

Lanyards as aforeſaid, Ratlings D°.

Pendants of the Top-rope, as big as the Fore-ſhrowds, and as long as the Fore-yard.

Falls of the Top-rope, $\frac{7}{12}$ of the Pendant, and 5 times as long as the Fore Top-maſt.

Pendants of Burton-tackles, Cir. $\frac{1}{4}$ of the Di. of the Top-maſt, and $\frac{2}{3}$ of the Length.

Burton-falls, $\frac{2}{3}$ of the Pendants, and 7 times the Length.

Puttock-ſhrowds, as big as the Top-rope Fall, and $\frac{2}{3}$ of the Le. all together.

Standing Back-ſtay, as big as the Shrowds, and $\frac{2}{13}$ of the Le. of Fore-maſt and Fore Top-maſt put together: Each of them Standing Back-ſtays.

Lanyards as aforeſaid.

Stays, Cir. $\frac{2}{3}$ of the Di. of the Fore Top-maſt, and as long as the Back-ſtays.

Lanyards, as aforeſaid.

Runner, as big as the Stay, and twice as long as the Fore Top-maſt.

Top-ſail Hall-yards, $\frac{1}{9}$ of the Runner, and twice the Length, and $\frac{1}{2}$ the Length of the Top-maſt more.

Lifts, as big as the Hallyards, and 4 times the Le. of the Stay.

Beckets upon the Cap, as big as the Lifts, and $\frac{1}{4}$ the Le. of the Pendants of the Burton.

Slings, worn Rope, as big as the Puttock-ſhrouds, and 6 times as long as the Beckets.

Parrel Rope, Cir. $\frac{1}{4}$ of the Di. of the Top-maſt in the Cap. And for Le. allow 3 Feet for every Inch the Top-maſt is in the Cap.

Racking, $\frac{1}{4}$ of the Parrel Rope, and $\frac{1}{6}$ longer.

Horſes for the Yard, worn Rope, as big as the Parrel Rope, and $\frac{18}{19}$ of the Le. of the Yard for Length.

Top-ſail Sheets, Cir. $\frac{1}{3}$ of the Di. of the Fore Yard in the Slings, and twice the Le. of the Fore Yard each.

Span

Span worn, $\frac{1}{5}$ of the Sheet, and $\frac{1}{7}$ of the Length.

Lashers, as big as the Racking, and $\frac{1}{3}$ as long as the Lanyard of the Stay.

Bow-lines, Cir. $\frac{2}{3}$ of the Fore Bow-lines, and as long as the Top-sail Hallyards.

Bridles, as big as the Bow-lines, and $\frac{2}{7}$ of the Length.

Clew-lines, as big as the Top-sail Hallyards, and 8 times the Le. of the Fore Top-mast, and $\frac{1}{2}$ its Length.

Bunt-lines, as big as the Bow-lines, and $\frac{1}{2}$ as long as the Clew-lines.

Reef-tackle { Tye, as big as the Clew-lines, and $\frac{1}{2}$ as long as the Bow-line Bridles. Fall, $\frac{2}{5}$ of the Tye, and $\frac{1}{3}$ of the Le. of the Bow-lines.

Leech-lines, as big as the Bunt-lines, and as long as the Reef-tackle Fall.

Braces, as big as the Clew-lines, and $\frac{1}{4}$ of the Length.

Pendants of Braces, as big as the Braces, and $\frac{1}{16}$ of the Length.

Stay-sail Stay, worn $\frac{7}{9}$ of the Stay, and $\frac{2}{7}$ of the Length.

Cringles worn, as big as the Lanyards, and $\frac{1}{2}$ the Le. of the False Stay together.

Lanyards, $\frac{2}{7}$ of the Stay, and $\frac{1}{2}$ the Length.

Hall-yards, as big as the Reef-tackle Fall, and 3 times the Le. of the Stay.

Sheet, as big as the Hallyards, and $\frac{2}{3}$ of the Length.

Tack, $\frac{1}{3}$ bigger than the Sheets, and $\frac{1}{5}$ of the Length.

Reef-lines, $\frac{1}{2}$ as big as the Sheet of the Stay-sail, and 6 times as long as the Fore Top-sail Yard.

Rope-bands and Ear-rings, $\frac{1}{3}$ bigger than the Reef-lines, and $\frac{1}{9}$ longer together.

For the TOP-GALLANT MAST.

SHrowds, Cir. $\frac{2}{5}$ of the Di. of the Mast, and $\frac{2}{1\frac{2}{3}}$ of the Mast's Length.

Lanyards, as aforesaid.

Puttock Shrowds, as big as the Top-gallant Shrowds, and $\frac{1}{3}$ of the Length.

Stay, $\frac{1}{4}$ of the Bigness of the Shrowds, and twice as long as the Fore Top-mast.

Tye of the Hall-yards, as big as the Shrowds, and $\frac{1}{6}$ of the Le. of one Shrowd.

Hallyards, $\frac{1}{4}$ of the Tye, and as long as the Fore Maſt, Top Maſt, Top-gallant Maſt, and Stump of D°. put together in their extreme Lengths.

Lifts, $\frac{1}{2}$ the Shrowds, and $\frac{2}{3}$ of the Hallyards Length together.

Braces, as big as the Lifts, and 3 times the Le. of the Stay.

Pendants, as big as the Braces, and $\frac{1}{11}$ of the Length.

Parrel Rope, as big as the Pendants. Le. 2 Feet and $\frac{1}{2}$ for every Inch the Top-gallant Maſt is in the Cap.

Bow-lines, as big as the Braces, and $\frac{1}{7}$ of the Length.

Bridles, as big as the Bow-lines, and $\frac{1}{4}$ of the Length.

Clew-lines, as big as the Hallyards, and as long as the Braces.

For the MAIN MAST.

PEndants of the Tackles, Cir. $\frac{6}{22}$ of the Di. of the Main Maſt in the Partners. Le. $\frac{1}{2}$ the Length of the Maſt.

Runners, $\frac{2}{11}$ of the Pendants, and as long as the Fore Runners.

Tackle-falls, $\frac{7}{13}$ of the Pendants, and 8 times the Length.

Pendant of the Garnet, $\frac{1}{6}$ of the Runners of the Tackle, and $\frac{1}{2\frac{1}{2}}$ of the Length.

Guy of the Garnet, $\frac{4}{5}$ of the Pendant, and $\frac{2}{3}$ of the Length.

Garnet Fall, as big as the Main Tackle Fall, and $\frac{1}{2}$ the Le.

Shrowds, as big as the Pendants, and $\frac{1}{7}$ of the Le. of the Main Maſt.

Lanyards, as aforeſaid. Ratling D°. Worming D°.

Cat-harping Legs and Falls, twice as big as the Worming, and twice as long as the Main Yard.

Stays, Cir. $\frac{1}{2}$ the Di. of the Maſt, and $\frac{20}{21}$ of the Maſt's Length.

Lanyard, $\frac{1}{24}$ for Bigneſs of the Stay, and $\frac{2}{3}$ of the Length.

Laſher to the Foremaſt, $\frac{1}{2}$ the Lanyard, and $\frac{1}{3}$ of the Length.

Worming, $\frac{1}{6}$ of the Stay, and 5 times as long.

Collar, $\frac{3}{4}$ of the Stay for Bigneſs, and $\frac{7}{16}$ of the Length.

Woolding of the Maſt, for every Inch the Maſt is in Di. at the Partners, allow $\frac{1}{9}$ of an Inch for the Cir. of the Rope, and 9 times the Le. of the Main Maſt for Length.

Crow-foot for the Top, as big as the Worming, and as long as the Cat-harpings.

Tackle for D°. equal in Bigneſs, and $\frac{1}{8}$ of the Length.

Jeers, $\frac{1}{1\frac{1}{3}}$ of the Shrowds, and 8 times the Le. of each Shrowd, ſo that each Jeer is 4 times the Length of each Shrowd.

Laſhers to the Yard, $\frac{6}{11}$ of the Jeers, and $\frac{4}{7}$ of the Le. of one Jeer.

Tackles

Tackles for the Boats, $\frac{1}{7}$ of the Main Tackle, and as long as the Garnet.

Lifts, as big as the Main-tackle Falls, and twice as long as the Main-maſt and Yard put together, with $\frac{2}{5}$ of the Le. of the Main Yard added to them.

Strap for the Cap, as big as the Lanyards of the Shrowds, and five times as long as the Cap.

Braces, $\frac{6}{7}$ of the Lifts, and 5 times the Le. of the Main Yard.

Pendants, as big as the Braces, and $\frac{1}{10}$ of the Length.

Parrel-rope, Cir. $\frac{1}{6}$ of the Di. of the Maſt. And for every Inch the Maſt is, allow 3 Feet for Length, as aforeſaid.

Nave-line, $\frac{1}{2}$ of the Cat-harpings, or of equal Size and Le.

Racking and Seizing, $\frac{1}{4}$ of the Parrel, and $\frac{1}{2}$ as long again.

Horſes for the Yard, worn Rope, $\frac{9}{11}$ of the Jeers, and $\frac{20}{21}$ of the Le. of the Main Yard.

Lanyard, $\frac{1}{2}$ the Horſe, and $\frac{1}{3}$ of the Length.

Puddening to the Yard, as big as the Jeers, worn Rope, and 12 Cir. of the Yard in the Slings.

Sheet Cabled, as big as the Runners of the main Tackle, and $\frac{1}{15}$ longer than the Braces.

Stoppers, $\frac{1}{6}$ of the Sheets, and $\frac{1}{21}$ of the Length.

Lanyards, $\frac{1}{2}$ the Nave-line, and $\frac{2}{3}$ of the Stoppers for Le.

Tacks taper'd, as big as the Shrowds, and $\frac{1}{2}$ the Le. of the Braces.

Luff-tackles, $\frac{6}{13}$ of the Tack, and $\frac{7}{8}$ of the Length.

Bow-lines, as big as the Lifts, and $\frac{1}{5}$ longer than the Tacks.

Bridles, $\frac{6}{7}$ of the Bow-lines, and $\frac{2}{7}$ of the Length.

Tackle, $\frac{1}{6}$ of the Bridles, and of equal Length.

Clew-garnets, $\frac{1}{6}$ of the Braces, and $\frac{1}{6}$ of the Length.

Bunt-lines, $\frac{2}{5}$ of the Clew-garnets, and $\frac{1}{2}$ as long again.

Leech-lines, as big as the Bunt-lines, and $\frac{1}{2}$ as long.

Stay-ſail Stay, $\frac{1}{3}$ of the Main-ſtay, and $\frac{3}{4}$ of the Length.

Lanyard, as aforeſaid.

Cringles worn, $\frac{1}{8}$ of the Stay, and as long as the Lanyards together.

Hallyards, $\frac{1}{2}$ the Stay, and twice as long.

Sheet, $\frac{1}{8}$ of the Stay, and $\frac{1}{3}$ of the Length.

Tack, $\frac{3}{4}$ of the Stay, and $\frac{1}{2}$ the Le. of the Sheet.

Steering-ſail Hallyards, as big as the Stay-ſail Tack, and 3 times the Le. of the Main-maſt, $\frac{1}{4}$ the Le. added unto it.

Sheet, $\frac{1}{6}$ of the Hallyards, and $\frac{1}{4}$ the Length.

Tack, as big as the Hallyards, and $\frac{1}{2}$ the Length.

Reef-lines, $\frac{1}{4}$ of the Leech-lines, and 4 times the Le. of the Main Yard, and $\frac{2}{3}$.

Rope-bands and Ear-rings, as big as the Reef-lines, and $\frac{1}{4}$ as much longer, taken altogether.

For the MAIN TOP-MAST.

SHrowds, Cir. $\frac{9}{29}$ of the Di. of the Top-maſt in the Cap, and $\frac{16}{17}$ of the Le. of the Top-maſt.

Lanyards, as before.

Ratling, $\frac{2}{9}$ of the Shrowds, and $\frac{1}{16}$ for Le. of all the Shrowds.

Pendant of the Top-rope, Cir. $\frac{6}{29}$ of the Di. of the Top-maſt. For Le. $\frac{2}{3}$ of the Le. of the Main Maſt.

Top-rope Fall, $\frac{2}{3}$ of the Pendant, and 3 times the Length.

Pendants of Burtons, $\frac{7}{9}$ of the Shrowds, and $\frac{1}{2}$ as long as the Pendant of the Top-rope.

Fall, $\frac{4}{7}$ of the Pendant, and 6 times as long.

Puttock Shrowds, $\frac{8}{9}$ of the Top-maſt Shrowds, and $\frac{2}{5}$ of the Length.

Standing Back-ſtays, as big as the Shrowds, and $\frac{2}{13}$ of the Main-maſt and Main Top-maſt put together for one of them.

Lanyards, as aforeſaid.

Stay Cabled, as big as the Shrowds, and $\frac{6}{7}$ of the Le. of the Main-maſt and Main Top-maſt put together.

Runners of the Top-ſail Hallyards, Cir. $\frac{1}{2}$ the Di. of the Top-ſail Yard, and twice as long as the Main Top-maſt.

Hallyards, $\frac{1}{7}$ of the Runner, and twice the Length, with the Length of the Main Top-maſt added to it.

Lifts, $\frac{1}{2}$ the Runner, and 8 times the Le. of the Main Top-ſail Yard.

Beckets at the Cap, as big as the Lifts, and 6 times the Le. of the Cap.

Braces, as big as the Lifts, and $\frac{3}{4}$ of the Length.

Pendants as big as the Braces, and $\frac{1}{10}$ of the Length.

Beckets about the Mizon Maſt, as big as the Main Top-ſail Hallyards, and as long as the Beckets at the Main Top-maſt Cap.

Slings, worn Rope, as big as the Mizon Beckets, and 4 times the Le.

Parrel Rope, Cir. $\frac{1}{4}$ of the Di. of the Top-maſt in the Cap; and for Le. allow 3 Feet to an Inch, as aforeſaid.

Racking, one fourth of the Parrel, and as long as the Slings.

Horſes for the Yard, worn, as big as the Parrel-Rope, and $\frac{8}{9}$ of the Yard for Length.

Sheets, Cir. half the Di. of the Top-ſail Yard, and $\frac{6}{7}$ of the Le. of the Braces.

Span, worn Rope, half the Sheets, and $\frac{1}{1\frac{1}{3}}$ of the Length.

Laſhers, $\frac{1}{4}$ of the Ratling, and $\frac{1}{3}$ longer than the Le. of the Span.

Bow-lines, as big as the Hallyards, and $\frac{1}{1\frac{4}{5}}$ of the Length.

Bridles, as big as the Bow-lines, and $\frac{1}{1\frac{1}{4}}$ of the Length.

Clew-lines, as big as the Bow-lines, and 8 times as long as the Main Top maſt, and half as long.

Bunt-lines $\frac{2}{3}$ of the Clew-lines, and half as long.

Leech-lines, as big as the Bunt-lines, and $\frac{7}{1\frac{7}{7}}$ of the Length.

Reef-tackle Tyes, as big as the Braces, and as long as the Pendants of the Braces.

Fall, $\frac{3}{5}$ of the Tye, and 3 times as long.

Stay-ſail Stay, worn, $\frac{1}{9}$ of the Stay, and $\frac{2}{5}$ of the Length.

Lanyards, as aforeſaid.

Cringles, worn, $\frac{4}{7}$ of the Stay, and as long as the Lanyards together.

Hallyards, as big as the Reef-tackle Fall, and twice as long as the Stay.

Sheet, as big as the Hallyards, and $\frac{1}{6}$ of the Le.

Tack, as big as the Leech-lines, and $\frac{1}{3}$ of the Lanyard.

Steering-ſail Hallyards, as big as the Stay-ſail Stay, and 4 times as long as the Main Top-maſt, and $\frac{3}{4}$ of the Le. of the Top-maſt added to it.

Sheet, $\frac{4}{5}$ of the Hallyards, and one ſeventh of the Le.

Tack, as big as the Sheet, and one fourth of the Le.

Reef-lines, half as big as the Leech-lines, and 4 times the Le. of the Main Top-ſail Yard, with one third of the Length added unto it.

Rope-bands and Ear-rings, as big as the Reef-lines, and half longer, put together.

For the MAIN TOP-GALLANT MAST.

SHrowds, $\frac{1}{9}$ of the Top-maſt Shrouds, and $\frac{1}{1\frac{2}{3}}$ of the Top-gallant Maſt's Length.

Lanyards, as before.

Puttock Shrowds, as big as the Top-gallant Shrowds, and one third of the Length.

Stay, $\frac{1}{4}$ of the Shrowds, and twice the Le. of the Top-maſt, and one eighth of the Le.

Tye of the Hallyards, as big as the Shrowds, and one ſixth of the Le. of the Stay.

Hallyards, $\frac{1}{5}$ of the Tie, and twice as long as the Main Maſt.
Lifts, as big as the Hallyards, and $\frac{8}{9}$ of the Stays Le. together.
Braces, $\frac{2}{3}$ of the Lifts, and 3 times the Le.
Pendants, as big as the Braces, and $\frac{1}{12}$ of the Le.
Parrel-rope, as big as the Pendants, allowing 2 Feet in Le. for every Inch the Top-gallant Maſt is in the Cap.
Bow-lines, as big as the Lifts, and the Le. of the Braces.
Bridles, as big as the Bow-lines, and one twelfth of the Le.
Clew-lines, as big as the Bow-lines, and twice as long as the Hallyards.

For the MIZON MAST.

SHrowds, Cir. $\frac{2}{29}$ of the Di. of the Mizon Maſt in the Partners.
Le. $\frac{2}{3}$ of the Maſt, if it ſteps in the Hold, and $\frac{8}{9}$ if on the lower Deck.
Lanyards, as before. Ratling D°.
Pendants, $\frac{7}{9}$ of the Shrowds. Le. $\frac{2}{3}$ of one Shrowd.
Fall, $\frac{4}{7}$ of the Pendants, and 7 times the Le.
Stay, as big as the Shrowds, and as long as the Maſt, if it ſteps in the Hold.
Lanyards, as before.
Collar, $\frac{8}{9}$ of the Stay, and $\frac{5}{6}$ of the Le.
Crow-foot for the Top, one eighth of the Shrowds, and as long as the Stay.
Tackle for D°. as big, and a quarter of the Le.
Jeer, $\frac{8}{9}$ of the Shrowds. Le. twice that of the Mizon Maſt, if it ſteps in Hold, and half that Le.
Laſher, $\frac{5}{8}$ of the Jeers, and $\frac{1}{5}$ of the Le.
Parrel Rope, as big as the Laſhers, and for Le. allow 2 Feet, as aforeſaid.
Truſs, as big as the Parrel Rope, and twice as long as the Mizon Maſt ſtept on the Deck.
Slings, as big as the Shrowds, and as long as one Shrowd.
Sheet, $\frac{7}{9}$ of the Shrowds, and as long as the Truſs.
Tack, $\frac{5}{7}$ of the Sheet, and one ſixth of the Le.
Bow-lines, as big as the Tack, and as long as the Slings put together.
Middle Brails, Main Brails, and Peek Brails, $\frac{4}{5}$ of the Bow-lines for Bigneſs, and for Le. 6 times the Le. of the Mizon Maſt ſtept in Hold, and $\frac{1}{4}$ of ſuch a Le. added to it.

Lacing

Lacing for the Mizon, $\frac{1}{2}$ the Brails, and 3 times as long as the Mizon Yard, and $\frac{1}{3}$ of the Le.

Stay-ſail Hallyards, as big as the Brails, and as long as the Sheet.

D°. Sheet, as big as the Mizon Tack, and half the Le. of D°. Bow-lines.

Tack, $\frac{4}{5}$ of the Sheet, and $\frac{1}{4}$ of the Le. of D°.

For the CROSS-JACK YARDS.

STanding Liſts, as big as the Mizon Bow-lines, and $\frac{1}{4}$ of the Length.

Lanyards, $\frac{1}{3}$ of the Liſts, and $\frac{2}{3}$ of the Length.

Braces, $\frac{1}{5}$ of the Liſts, and 6 times the Le.

Pendants, $\frac{4}{5}$ of the Liſts for Bigneſs, and $\frac{1}{15}$ of the Le. of the Braces.

Slings, as big as the Mizon Sheet, and $\frac{2}{3}$ the Le. of the Standing Liſts.

For the MIZON TOP-MAST.

SHrowds, as big as the Main Top-gallant Maſts, and as long as the Mizon Top-maſt.

Lanyards, as before.

Puttock Shrowds, as big as the Top-gallant Maſt Shrowds, and as long as the Lanyards.

Stay, as big as the Shrowds, and twice the Le. of the Top-maſt.

Lanyards, as before.

Tye, as big as the Stay, and $\frac{7}{8}$ of the Le. of the Top-maſt.

Hallyards, $\frac{4}{5}$ of the Tye, and twice the Le. of the Mizon Top-maſt ſtept on the Deck.

Liſts, $\frac{1}{3}$ of the Shrowds, and 5 times the Le. of the Mizon Top-maſt both together.

Braces, as big as the Liſts, and 8 times the Le. of the Top-maſt, and half that Length.

Pendants, as big as the Braces, and $\frac{1}{14}$ of the Length.

Parrel-Rope, as big as the Pendants, allowing two Feet in Le. for every Inch the Maſt is in the Cap.

Sheets, as big as the Shrowds, and $\frac{16}{17}$ of the Braces for Length.

Bow-lines, $\frac{2}{5}$ of the Sheets, and equal in Length.

Bridles, as big as the Bow-lines, and $\frac{1}{6}$ of the Length.

Clew-lines, as big as the Braces, and as long as the Bow-lines.

Other Neceſſary ROPES.

VIOL cabled, as big as the Fore Stay, and the Le. of the Gun-deck, and $\frac{5}{13}$ of that Length.

Straps, $\frac{7}{10}$ of the Viol, and $\frac{1}{5}$ that Length.

Laſhers, $\frac{1}{2}$ the Straps, and twice their Length.

Pendant of the Winding Tackle, $\frac{4}{5}$ of the Viol, and $\frac{4}{5}$ the Le. of the Main Maſt.

Fall of D°. $\frac{1}{2}$ the Viol, and 3 times the Le. of the Pendant.

Pendant of the Fiſh-tackle, $\frac{13}{16}$ of the Pendant of the Winding Tackle, and $\frac{1}{3}$ of the Le. of the Gun-deck.

Fall of D°. $\frac{7}{13}$ of the Pendant, and 4 times as long.

Cat Ropes, $\frac{9}{13}$ of the Pendant of the Fiſh-tackle, and 7 times the Breadth of the Ship, both of them together, for Length.

Lanyards, as aforeſaid.

Stoppers of Anchors, $\frac{11}{13}$ of the Pendant of the Fiſh-tackle, and each of equal Le. to the Pendant.

Shank-painters, as big, and $\frac{1}{7}$ of the Length.

Stoppers at the Bit, $\frac{4}{5}$ of the Viol for Bigneſs, and near 3 Feet long.

Seizings, $\frac{1}{12}$ of the Stoppers, allowing 2 Fathom and $\frac{1}{4}$ to one Fathom of the Stoppers for Length.

Lanyards, $\frac{3}{8}$ of the Stoppers, and $\frac{6}{10}$ the Le. of the Seizings.

Buoy Ropes Cabled, as big as the Pendant of the Fiſh-tackle, and each as long as the Cat-rope ſingle.

Buoy Slings, $\frac{7}{13}$ of the Buoy-ropes for Bigneſs.

Gun-ſlings, $\frac{7}{8}$ of the Winding Tackle Pendants, for Bigneſs.

Butt-ſlings, $\frac{6}{7}$ of the Gun D°.

Hogſhead-ſlings, $\frac{4}{6}$ of the Butts.

Nut-ſlings of the Guns, $\frac{1}{4}$ of the Hogſheads.

Horſes in the Head, worn, $\frac{7}{11}$ of the Gammoning, and 5 times the Length of the Head, on a middle Line, from the Stem to the Fore-part of the Lion, both.

Lanyards, as aforeſaid.

Poop Ladders, worn, as big as the Mizon Jeers, and 7 times the Ship's Draught of Water abaft for Le. both of them.

Middle Rope, $\frac{1}{3}$ of the Sides, and $\frac{7}{9}$ of the Length.

Laſher, $\frac{2}{3}$ of the Middle Rope, and $\frac{4}{7}$ the Length.

Puttock Staves, as big as the Mizon Shrowds.

Cable Bends, $\frac{5}{11}$ of the Shank-painters or Stoppers for Bigneſs.

Entring Ropes, generally 3 Inch Rope.

Port

Port Ropes, for every 6 Inches the Port is ſquare, allowing $\frac{1}{2}$ an Inch for the Circumference of the Rope.

Puddenings of Anchors, as big as Cable-bends.

Seizings, $\frac{1}{3}$ of the Puddenings.

For the LONG-BOAT.

MAin Stay, as big as the Mizon Top-maſt Shrowds.
Tye D°. Hallyards, $\frac{3}{5}$ of D°.

Pendants of Burton, $\frac{1}{3}$ more than the Stay. Fall $\frac{2}{3}$ of the Tye.

Fore Sheets, $\frac{1}{2}$ the Burton-fall. Hallyards D°.

Main Sheet, as big as the Burton-fall. Tack D°.

Boat-rope cabled, as big as the Buoy-ropes, and for Le. let it be the Le. of the Ship aloft, extreme.

Gueſt Rope, $1\frac{2}{3}$ of the Boat-rope, and $\frac{1}{5}$ longer.

Painter, $\frac{3}{4}$ the Boat-rope, and $\frac{1}{5}$ of the Le.

Yard Rope, $\frac{1}{2}$ the Hallyards, and twice the Length of the Main Stay.

For the PINNACE.

MAin Sheet, as big as the Long-boat's Fore Sheets.
Fore Sheets, $\frac{7}{8}$ of the Main Sheets.

Boat-rope, cabled, $\frac{8}{11}$ of the Long-boat's Rope for Bigneſs, and as long as the Gueſt Rope.

Gueſt Rope, $\frac{7}{8}$ of the Boat-rope, and $\frac{7}{8}$ of the Le.

Painter, $\frac{1}{7}$ of the Gueſt Rope, $\frac{1}{6}$ of the Length.

The ſeveral Sizes of STRAPPINGS *and* SEIZINGS.

Inch.		
6	Rope-	4 times the Length of one Main Shrowd, or 40 Fathom.
$5\frac{1}{2}$	——	$\frac{1}{2}$ that Le. of the 6 Inches.
5	——	$\frac{3}{4}$ of the 6 Inches.
$4\frac{1}{2}$	——	As much as of 6 Inches.
4	——	D°.
$3\frac{1}{2}$	——	D°.
3	——	D°.
$2\frac{1}{2}$	——	$\frac{1}{4}$ as much more of this than of 3 Inch.
2	——	D°.
$1\frac{1}{2}$	——	As much as of 6 Inches.

And this is ſufficient to ſtrap every Block belonging to all the Rigging.

SEIZ-

SEIZINGS.

Inch.		
2	Rope	As much as of the 5 Inch Strapping in Fathoms.
1 ½	Rope	⅔ of the 2 Inch.
1	Rope	11 times as much as of 1 Inch and ½.
¾	Rope	D°.

Spun Yarn, for every Inch the Main Stay is in Di. allow 5 Hundred Weight.

To every Hundred Weight of ſpun Yarn allow 3 tarred Lines.

To every tarred Line allow ¼ of a Pound of tarred Mar-line.

To every 30 tarred Lines allow one White Line.

To every White Line allow 1 Pound and half of White Mar-line.

To every Hundred Weight of ſpun Yarn allow 8 Yards and half of old Canvas.

To every 8 Hundred Weight of ſpun Yarn allow half a Barrel of Tar.

For every Yard the Main Maſt meaſures on the Superficies that is paid with Roſin, allow one Pound ½ of Roſin to pay all the Maſts.

To every Pound of Roſin allow one Pound and ⅔ of a Pound of Tallow.

For every 15 Pound of Roſin allow one Gallon of Oil.

To every Gallon of Oil allow two Barrels of Blacking, which is for the Maſts Heads and Yards to pay them.

For every Fathom of Woolding allow five Nails.

To every 300 of Nails allow one Leather Bucket.

To every White Line allow 2 Pounds and an half of Twine, and two Log-lines.

To every Main Shroud allow 3 Trucks for the whole Rigging.

To every Barrel of Tar allow one Bruſh.

And for every four Barrels of Blacking one Bruſh.

A TABLE *of the Thickneſs of all* ROPES *belonging to any* SHIP, *from a Maſt of* 12 *Inches to* 34 *Inches through.*

The USE of the TABLE.

FInd the Diameter of the Main-maſt at the Top of the *Column*, and under that, and againſt the *Name of the Rope*, you have the *Thickneſs* of the ſaid Rope.

EXAMPLE:

Suppoſe in a Ship whoſe Main-maſt is 30 Inches through, and I deſire to know the *Thickneſs* of the Main-ſtay: I look for the *Maſt of* 30 *Inch.* at the top of the Table, *Page* 74, and under it, againſt [Stay] I find 15; which ſhews, that a Ship whoſe Main-maſt is 30 Inches through, or in Diameter, requires a Main-ſtay of 15 Inches.

Again: If the Fore-top-gallant Stay of the ſame Ship is required, look in *Page* 80, for *The Bigneſs of Fore-top-gallant Rigging*; you will, under 30, the Diameter of the Main-maſt, find 2 Inches the *Thickneſs* of the Fore-top-gallant Stay. And ſo in all others.

The Bigneſs of the Rigging for theſe Main-maſts, and Main-top-maſts.

The Fore-maſt to theſe Maſts followeth in the next Page.

	1 *Maſt of 34 Inch.*	2 *Maſt of 32 Inch.*	3 *Maſt of 30 Inch.*	4 *Maſt of 29 Inch.*	5 *Maſt of 28 Inch.*	6 *Maſt of 27 Inch.*	7 *Maſt of 26 Inch.*	8 *Maſt of 24 Inch.*	9 *Maſt of 23 Inch.*	10 *Maſt of 19 Inch.*	11 *Maſt of 13 Inch.*	12 *Maſt of 12 Inch.*
	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch
Pendant of Tackles	8 1/2	8	7	6 1/2	6	5 1/2	5	7	6	5	4	4
Runners	6	5 1/2	5	5	4 1/2	4	3 1/2	5	5	4 1/2	3 1/2	3 1/2
Falls of the Tackles	4	4	3 1/2	3 1/2	3	3	3	3 1/2	3 1/2	2 1/2	2 1/2	
Shrouds	8 1/2	8	7 1/2	7	6 1/2	5	5	7	6	5	4	4
Lanyards	4 1/2	4	4	3 1/2	3	3	3	4	3 1/2	3 1/4	2 1/2	2 1/2
Swifters	8 1/2	8	7 1/2	7	6 1/2	5	5	5 1/2	5	4 1/2	3 1/2	
Lanyards	4 1/2	4	4	3 1/2	3 1/2	3	2 1/2	3 1/4	3	3	2 1/2	
Stay	17	16	15	14 1/2	14	10	8	12	11 1/2	9 1/2	6 1/2	6
Collar at the Stem	16	15	13	12	11	9	8	10	10	8	6	
Lanyard of the Stay	6	5 1/2	5 1/2	5	4	4	3 1/2	4	4	3 1/2	2 1/2	3
Lifts	4 1/2	4	3 1/2	3 1/2	3	3	2 1/2	3	3	2 1/2	2 1/2	2
Tacks	9 1/2	9	8 1/2	8	6 1/2	6	5	6 1/2	6	5 1/2	4	4
Sheets	6 1/2	6 1/2	6	6	5	4 1/2	4	4 1/2	4 1/2	3 1/2	2 1/2	3
Bow lines	5 1/2	5	4 1/2	4 1/2	4	4	3	3	3	2 1/2	2 1/2	2 1/2
Bridles	4 1/2	4 1/2	4	4	3 1/2	3 1/2	3	3	3	2 1/2	2	
Pendants Fore-braces	4	4	3 3/4	3 1/2	3	3	2 3/4	3	3	2 1/2	2	2 1/2
Braces	3	3	3	3	2 1/2	2 1/2	2	2 1/2	2 1/2	2	1 1/2	2
Clue-garnets	4	3 1/2	3	3	2 1/2	2 1/2	2	3	2 1/2	2 1/2	1 1/2	2
Jeers	8 1/2	8	7	6	5 1/2	5		6	4 1/2	4		
Parrel-rope	6	6	5	5	4 1/2	4	3	4 1/2	4	3 1/2	3	3
Breaſt-rope	8	7	6	6	5							
Runner of Mart-lines	2 1/2	2 1/2	2 1/2	2 1/2	2	2						
Fall of Mart-lines	3	2 1/4	2 1/4	2	2	2		2 1/2	2	2	1 1/2	
Pendant of the Garnet	8 1/2	8	7 1/2	7	6	5	4 1/2	6	5 1/2	5	5	4
Tye	6	5 1/2	5	5	4 1/2	4	3 1/2	3 1/2	3 1/2	3	3	3
Fall of the Garnet	4 1/2	4	4	4	3 1/2	3 1/2	3	3	3	2 1/4	2	2

Note, *Their* Bunt-lines *are in Bigneſs as followeth,*

3 1/2 3 1/2 3 2 1/2
2 2 2 2
2 2 2 2 1/2

Note, *The Ships that have no* Jeers, *their* Tye *is* 4 Inches, *and their* Halyards *is* 2 1/2.

Main-top-maſt Rigging	1	2	3	4	5	6	7	8	9	10	11	12
Pendant of Tackles	5	5	4 1/2	4	3 1/2	3	2 3/4	3 1/2	3 1/2	2 1/2		2
Falls of Tackles	2 1/2	2 1/2	2 1/2	2 1/2	2	2	1 1/2	2	2	1 1/2		1 1/2
Shrouds	5	5	4 1/2	4	4	3	3	4	3 1/2	3	2 3/4	2 1/2
Lanyards	2 1/2	2 1/2	2 1/2	2	2	2	1 1/2	2	2	1 1/2	1	1
Back-ſtays	5	5	5	4	3 1/2	3	2 1/2	4	4	3 1/2	2	2 1/2
Lanyards	3	3	3	2 1/2	2 1/2	2	2	2 1/2	2	1 1/2	1	1
Stay	8	7	6	5	5	4 1/2	4	5	4 1/2	3 1/2	3	2 1/2
Lanyard	4	4	3	3 1/2	3	3	2 1/4	3	2 1/2	2	1 1/2	2
Liſts	3 1/2	3	2 1/2	2 1/2	2	2	2 1/4	2	2	1 1/2	1	1

The

The Bigneſs of Fore Rigging	1	2	3	4	5	6	7	8	9	10	11	12
Pendants of Tackles	8	7½	7	6	5	5	5	6¼	5½	4½	3½	6
Runners of Tackles	5½	5	5	5	4	4	4	5	5	4½	3	2⅝
The Falls	4	3½	3½	3½	3	3	3	3½	3	2½	2	
Shrouds	8	7½	6½	6	5½	5	4½	6	5½	4½	3½	3½
Lanyards	4	4	4	4	3½	2½	2	3½	3½	3	2	2
Swifters	8	7½	7	6	5½	5	4½					
Lanyards	4	4	4	4	3½	3½	3					
Stay	15	13	12	11	9	7	6½	10½	8½	7½	5	4
Lanyard	5	5	5	4½	4	3½	3	4	3½	3	2	2
Tye	8	7½	7	7	6	6	5	5½	5	5	3½	4
Hallyards	6	6	6	5	4½	3½	3	3	3½	3	2	2
Jeers	6½	6	6	6	4	4	5¾					
Lifts	4	3½	3½	3	3	2½	2	3	3	2½		2
Parrel-ropes	5	5	4½	4½	4	4	3	3	3	2½	2	2½
Breaſt-ropes	8	7	6½	6	5							
Sheets	6	6	5	5	4¾	4	3¾	4¾	4	3½	2¾	2¾
Jacks	8½	8	7	7	6	5	4¼	6	6	5	5	3⅝
Bow-lines	4½	4½	4	3½	3½	3	3	3¼	3	2½	2	2½
Bridles	4½	4	3½	3	3	3	2	3½	3	2½	2	2
Pendants of Braces	4	3½	3	3	2½	2½	2½	3	3	2½	1½	2
Braces	3	3	2½	2½	2	2	2	2½	2½	2	1¼	1½
Clue-garnets	3½	3	3	2½	2	2	2	3	2½	2	1½	1½
Bunt-lines	3	3	2½	2½	2	2	2	2	2	2	1½	1½
Mart-line Runners	3	2½	2½	2½	2							
Mart-lines	2½	2½	2½	2	2	2½	2	2	1½			

The Bigneſs of the Fore-top-ſail Rigging.	1	2	3	4	5	6	7	8	9	10	11	12
Pendants of Tackles	4½	4	3½	3	2½	2½	3½	3½	3	2½		
Falls to them	2½	2	2	2	1½	1½	2	2	2	1½		
Shrouds	4½	4	3½	3½	3	3	2½	4	3	3	2	2
Lanyards	2	2	2	2	1½	1½	2	2	1½	1½	1	1
Puttocks	5	4½	4½	4	3½	3	2¾	3	3	2½	1½	
Stay	5	5	5	4½	4	3	3	4½	4	3½	2	2½
Pendant of the Lanyard	4	3½	3½	3	2½	2½	1¾					1½
Fall of the Lanyard	3½	3½	3	2½	2	2	2	3	2½	2	1½	1½
Tye	7	7	6½	6½	5½	5	5	6	5	3½	2	
Runner	5	5	4¾	4¾	4	4	4	4½	4	3½		
Hallyards	5	4½	4	4	3½	3½	2¾	3	2½	2	1½	
Bow-lines	4	3½	3	3	2½	2½	2½	2	2	1½	1¾	
Bridles	3½	3½	3	3	2½	2	1½	2	1½	1½	1½	
Clue-lines	4¼	4	4	3½	3	2½	2	3	2½	1½	1½	
Parrel-rope	4	4	4	3¾	3½	3	2	3½	3	2½	2	

The Bigneſs of the Bowſprit Rigging.	*Maſt of 34 Inch.* 1 Inch	*Maſt of 32 Inch.* 2 Inch	*Maſt of 30 Inch.* 3 Inch	*Maſt of 29 Inch.* 4 Inch	*Maſt of 28 Inch.* 5 Inch	*Maſt of 27 Inch.* 6 Inch	*Maſt of 26 Inch.* 7 Inch	*Maſt of 24 Inch.* 8 Inch	*Maſt of 23 Inch.* 9 Inch	*Maſt of 19 Inch.* 10 Inch	*Maſt of 13 Inch.* 11 Inch	*Maſt of 12 Inch.* 12 Inch
Pendants of Sheets	6	6	5½	5½	4½	4	3½	5	4½	4	3	2½
Sheets	4½	4½	4	3	3	2½	2½	4	3½	3¼	3	1½
Clue-lines	3	3	3	2½	2	2	2	3	2½	2	1½	1½
Garnets	3½	3	3	3	2½	2½	2	3	3	2½	1¾	
Pendants of Braces	4	4	3	3	2½	2½	2½	3	2½	2	1¾	1½
Braces	2½	2½	2½	2½	2	2	2	2½	2	1¼	1¾	1½
Hallyards	4½	4	3½	3½	3½	3	2¼	3½	3	2¾	2½	2
Tye	7	6	6	6	5	4½	4	6	5	5	4½	2
Bunt-lines	3	3	2½	2½	2	2	1⅝	2½	2½	2	1½	
Hoſſe	6	6	5½	5¼	5	4	3	3	3	3	2½	2½
Lifts	4	3	3	3	2½	2	2	3	3	2½	2	1½

The Bigneſs of the Spritſail-top Rigging.	1	2	3	4	5	6	7	8	9	10	11	12
Shrouds	3	3	2½	2½	2	2	1½	2½	2¾	2	1½	1
Lanyards	2	1¾	1¾	1½	1	1	1	2	1½	1	1	1
Pendants of Braces	2½	2½	2	2	1½	1½	1½	2	1¾	1½	1½	1
Braces	2	1½	1½	1½	1½	1	1	2½	1	1	1	1
Tye	3	3	3	2½	2	2	1½	1	1½	1½	1¼	1
Hallyards	2	2	2	2	1½	1½	1½	2	1½	1¾	1	1
Clue-lines	2½	2	2	2	1½	1½	1	2	1½	1½	1	1
Pendants of Tackles	3	3	2¼	2	1½	1½	¾	1½			¾	
Falls to them	2	2	1¾	1½	1	1	1					
Lifts	2	2	1½	1½	1½	1½	1	1¾	1½	1	1	1
Puttocks	3	3	2½	2	2	2	2	2½	2	2	2	1
Parrel-ropes	2	2	1¾	1½	1½	1½	1	1¾	1½	1½	1	1

The

The Bigneſs of Mizen Rigging.

The Mizen-maſt.	*Maſt of 34 Inch.* 1 Inch	*Maſt of 32 Inch.* 2 Inch	*Maſt of 30 Inch.* 3 Inch	*Maſt of 29 Inch.* 4 Inch	*Maſt of 28 Inch.* 5 Inch	*Maſt of 27 Inch.* 6 Inch	*Maſt of 26 Inch.* 7 Inch	*Maſt of 24 Inch.* 8 Inch	*Maſt of 23 Inch.* 9 Inch	*Maſt of 19 Inch.* 10 Inch	*Maſt of 13 Inch.* 11 Inch
Pendants of Tackles	5½	5	4½	4							
Runners	4	3½	3½	3							
Falls of Tackles	3	3	2½	2½							
Shrouds	5½	5	4¾	4½	3½	3	2½	4	4	3	2
Lanyards	3	2½	2½	2½	2	2	1½	2	2	1½	1½
Tye	7	6½	6	5	5	4½	4				
Hallyards	5	4½	3½	3	2½	2½	2	3½	3	2½	2
Stay	6	5	4	3½	3½	3½	3	4	4	3	2½
Lanyards	3¼	3	2½	2½	2	2	1½	2½	2	1½	1
Sheet	4	3½	3	2½	2½	2½	2	3	3	2½	2
Jeer	5½	5	4	3½	3½						
Truſs	3½	3	2½	2½	2	2	1½	2½	2	2	1½
Bow-lines	4	3	2	2	2	2	1¾	2½	2	1½	1½
Brayles	2½	2	2	2	2	2	1½	2	1¾	1½	1½
Parrel-rope	5½	5	4	3	3	3	2½	3½	3	2½	2

The Croſs-jack.	1	2	3	4	5	6	7	8	9	10	11
Lifts	4	3½	2½	2½	2	1½	1	2½	2½	2	1½
Braces	2½	2½	2	2	1½	1	1	2	1¾	1½	1
Pendants	3½	3	2½	2¼	2	1½	1¼	2	1½	1¾	1
Hallyards	4	3½	3	3	2½	2	1½	2	1¾	1½	1

Bigneſs of Mizen-top-maſt Rigging.

	Maſt of 34 Inch.	*Maſt of 32 Inch.*	*Maſt of 30 Inch.*	*Maſt of 29 Inch.*	*Maſt of 28 Inch.*	*Maſt of 27 Inch.*	*Maſt of 26 Inch.*	*Maſt of 24 Inch.*	*Maſt of 23 Inch.*	*Maſt of 19 Inch.*	*Maſt of 13 Inch.*	*Maſt of 12 Inch.*
	1 Inch	2 Inch	3 Inch	4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch	11 Inch	12 Inch
Pendants of Tackles	3 1/2	3	2 1/2	2 1/2								
Falls of Tackles	2 1/2	2 3/4	2	2								
Shrouds	3	3	2 1/2	2 1/2	2	1 1/2	1	2	2	2		
Lanyards	2	1 1/2	1 1/2	1 1/2	1 1/2	1	1 1/4	1	3/4			
Puttocks	3 1/2	3	2 1/2	2 1/2	2	1 1/2	2	1 1/2	1 1/2	1		
Pendants of Braces	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1	2	1 1/2	1 1		
Braces	2	2	1 3/4	1 1/2	1	1	1	1	3/4			
Bow-lines	2 1/2	2	1 3/4	1 1/2	1 3/4	1	1	1 1/2	1	3/4		
Bridles	2	2	1 1/2	1 1/4	1	1	1	1	1	3/4		
Clue-lines	2	2	1 3/4	1 1/2	1 1/2	1 1/2	1	2	1 1/2	1 1/2	1	1
Tye	3	3	3	2 1/2	2 1/2	2 1/2	2	3	2	2	2	1 3/4
Hallyards	2 1/2	2 1/2	2	2	1 1/2	1 1/2	1 1/4	2	1 1/2	1 1/2	1 1/2	1
Lifts	2	2	1 3/4	1 1/2	1 1/2	1 1/2	1	1	1	1	3/4	1
Parrel-rope	3	2 1/2	2	1 3/4	1 3/4	1 1/2	1 1/2	2	1 1/2	1 1/2	1	1
Runner of the Stay	2 1/2	2 1/2	2									
Pendant of the Stay	3	3	2 1/4	2	1 1/2							
Top-rope	3 1/4	3 1/4	3 1/2	2 1/2	2	2	1 1/2					
Parts of the Stay	2	2	1 1/2	1 1/2	1	1	1					
Pendant for Back-ſtays	3	2 1/2	2 1/2									
Falls	2 1/2	2	1 3/4									

The

The Bigneſs of the Main-top-gallant Rigging.

	Maſt of 34 Inch.	*Maſt of 32 Inch.*	*Maſt of 30 Inch.*	*Maſt of 29 Inch.*	*Maſt of 28 Inch.*	*Maſt of 27 Inch.*	*Maſt of 26 Inch.*	*Maſt of 24 Inch.*	*Maſt of 23 Inch.*	*Maſt of 19 Inch.*	*Maſt of 13 Inch.*	*Maſt of 12 Inch.*
	1 Inch	2 Inch	3 Inch	4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch	11 Inch	12 Inch
Pendants of Tackles	3	3	2 1/2	2	2	2	2					1 1/2
Falls of Tackles	2 1/2	2	3 3/4	3 1/2	3	3	1 3/4					1 1/2
Shrouds	3	3	3 3/4	3 1/2	3	3	2 3/4	2	2	1 3/4	1 1/2	1
Lanyards	1 3/4	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1	1	1	1	1	1
Puttocks	3 1/2	3	2 1/2	2	2	2	1 1/2	1 1/2	1 1/2	1	1	1
Pendants of Back-ſtays	3	3	2 1/2	2	2	2						
Falls to them	2	2	1 1/2	1 1/2	1	1						
The Stay	3	3	3	2 1/4	2	2	1 1/2	2	1 1/2	1	1	1
Lanyard	2 1/2	2 1/2	2 1/2	2	2	2	1 1/2	1 1/4	1 1/4	1	1	1
Braces	2	1 1/2	1 1/4	1 1/4	1 1/4	1	1	1	1	3/4	3/4	3/4
Pendant of Braces	2 1/2	2 1/2	2	2	1 1/2	1 1/2	1	1	1	1	1	1
Bow-lines	2 1/2	2	1 3/4	1 1/2	1 1/2	1 1/2	1	1	1	3/4	3/4	3/4
Bridles	2	1 1/2	1 1/4	1 1/4	1	1	1	1	1	3/4	3/4	
Top-rope	4 1/2	4	3 1/2	2 1/2	2	2						
Parrel-rope	2 1/2	2	2	2	1 3/4	1 1/2	1	1 1/2	1	1	1	1
Tye	3	3	3	2 1/2	2 1/2	2	1 3/4	2 1/2	2	2	1 3/4	1 3/4
Hallyards	3	2 1/2	2	2	1 3/4	1 1/2	1	1 1/2	1 1/2	1 1/2	1 1/4	1 1/4
Lifts	2 1/2	2	1 1/2	1 1/2	1	1	1	1	1	1	1	1
Flag-ſtaff-ſtay	2 1/2	2	1 1/2	1 1/2	1	1					1/4	
Clue-lines	2	2	1 3/4	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/4	1	1

The

The Bigneſs of the Fore-top-gallant Rigging.

	Maſt of 34 Inch.	*Maſt of 32 Inch.*	*Maſt of 30 Inch.*	*Maſt of 29 Inch.*	*Maſt of 28 Inch.*	*Maſt of 27 Inch.*	*Maſt of 26 Inch.*	*Maſt of 24 Inch.*	*Maſt of 23 Inch.*	*Maſt of 19 Inch.*	*Maſt of 13 Inch.*	*Maſt of 12 Inch.*
	1 Inch	2 Inch	3 Inch	4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch	11 Inch.	12 Inch
Tye	2 1/2	2 1/2	1 3/4	1 5/8	1 5/8	1 1/2	1 1/4	2 1/2	2	1 1/2	1 3/4	1 3/4
Hallyards	2 1/2	1 1/2	1 1/2	1	1	1	1	1 1/2	1 1/2	1	1	1
Bow-lines	2	2	1 1/2	1 1/8	1 1/4	1 1/4	1	1	1	3/4		
Bridles	1 3/4	1 1/2	1 1/4	1 1/2	1 1/2	1 3/4	1	1	1	3/4		
Stay	2 1/2	2 1/2	2	2	1 3/4	1 1/2	1	1 1/2	1 1/2	1		
Shrouds	2 1/8	2 1/2	2	2	1 3/4	1 1/2	1	2	1 1/2	1		
Lanyards	1 1/2	1 1/2	1 1/2	1	1	1	1	1 1/4	1 1/4	3/4		
Parrel-rope	2	2	1 1/8	1 1/2	1	1	1	1 1/2	1 1/2	1		
Clue-lines	2	1 3/4	1 1/2	1 1/2	1 1/4	1 1/4	1	1 1/2	1 1/2	1		
Braces	2	1 1/2	1 1/4	1 1/4	1 1/4	1	1	1	1	3/4		
Lifts	2	1 1/4	1 1/2	1 1/2	1 1/4	1	1	1	1	1		
Top-rope	1 1/2	3	3	2 1/2								
Pendant of Tackles	3	2 1/2	1 1/2									
Falls	2 1/4	2	2									
Puttocks	3	2 1/2	2 1/2	2	1 3/4	1 1/2	1 1/2	1	1	1	1	1
Back-ſtays	2 1/2	2 1/2	2									

Weight

Number, Weight, and Size of ANCHORS and CABLES for a Ship of each Claſs.

		Anchors.		Cables.	
Rate.	Guns.	N°.	Weight of each. C. Q. lb	N°.	Size of each. Inches.
1	100	5	77 3 0	9	23 ½
	Stream	1	20 0 0	1	14
	Kedge	1	10 0 0		
2	90	5	71 3 0	9	22 ½
		1	17 0 0	1	13 ½
		1	9 2 0		
3	80	4	65 3 0	8	21 ½
		1	16 0 0	1	13
		1	8 2 0		
	70	4	56 2 0	7	20 ½
		1	14 0 0	1	12 ½
		1	7 2 0		
4	60	4	51 2 0	7	19 ½
		1	12 0 0	1	11 ½
		1	6 2 0		
	50	4	46 2 0	7	18 ½
		1	11 2 0	1	11
		1	6 0 0		
5	40	4	37 3 0	7	17
		1	9 2 0	1	10
		1	5 0 0		
6	24	4	29 1 0	6	15 ½
		1	6 2 0	1	8
		1	3 0 0		
Sloops.		3	15 0 0	5	13
		1	7 0 0	1	8
		1	3 2 0		

A CORDAGE TABLE, *shewing how many Fathoms, Feet and Inches, of a Rope of any Size under* 14 *Inches, makes a Hundred Weight; with the Construction of the Table, and Rules to calculate the Weight of Ropes to any larger Circumference.*

I.	F.	F.	I.	I.	F.	F.	I.	I.	F.	F.	I.
1	486	0	0	6	13	3	0	11	4	0	3
¼	313	3	0	¼	12	2	0	¼	3	5	7
½	216	3	0	½	11	3	0	½	3	4	1
¾	159	3	0	¾	10	4	0	¾	3	3	3
2	121	3	0	7	9	5	6	12	3	2	3
¼	96	2	0	¼	9	1	6	¼	3	2	1
½	77	3	0	½	8	4	0	½	3	2	0
¾	65	4	0	¾	8	3	6	¾	2	7	8
3	54	0	0	8	7	3	6	13	2	5	3
¼	45	5	2	¼	7	0	8	¼	2	4	9
½	39	3	0	½	6	4	3	½	2	4	0
¾	34	3	9	¾	6	2	1	¾	2	3	6
4	30	1	6	9	6	0	0	14	2	2	1
¼	26	5	3	¼	5	4	0				
½	24	0	0	½	5	2	0				
¾	21	3	0	¾	5	0	6				
5	19	3	0	10	4	5	0				
¼	17	4	0	¼	4	4	1				
½	16	1	0	½	4	2	2				
¾	14	4	6	¾	4	1	8				
6	13	3	0	11	4	0	3				

The

The Uſe of the Cordage-Table.

THE Letters *I. F. F. I.* at the Top of the Table ſignify *Inches*, *Fathoms*, *Feet* and *Inches*. The firſt Column being the Thickneſs of the Rope in Inches and Quarters, and the other three the Fathoms, Feet and Inches that make up an hundred Weight of ſuch a Rope. One *Example* will make it plain.

Suppoſe I deſire to know how much of a 7 Inch Rope will make an hundred Weight; find 7 in the fifth Column under *I*, or *Inches* thickneſs of the Rope, and againſt that, in the ſixth, ſeventh, and eighth Columns, you find 9 | 5 | 6; which ſhews, that (in a Rope of 7 Inches) 9 Fathom, 5 Feet, and 6 Inches, is required to make an hundred Weight. And ſo in a 9 Inch Rope, 6 Fathom makes an hundred Weight: And in a 3 Inch Rope, 54 Fathom makes an hundred Weight, *&c.*

The Conſtruction of this TABLE *is from hence.*

A Rope of 1 Inch about, requires 486 Fathom to make up an hundred Weight; and, as the ſuperficial Content of all Circles are in proportion to the Squares of their Diameters, (and conſequently to the Squares of their Circumferences) it will follow, that as a Rope of 1 Inch in Circumference, whoſe Square is alſo 1, has 486 Fathom to an hundred Weight; 486 divided by the Square of the Circumference, or Girt of any other Rope, the Quotient will give the Number of Fathoms in an hundred Weight. As for *Example:* In a 9 Inch Rope 9 times 9 is 81, by which divide 486, the Quotient is 6, the Fathoms in an hundred Weight. And ſo for a 3 Inch Rope, 3 times 3 is 9, by which divide 486, the Quotient is 54 Fathom to an hundred Weight, as in the Table; and where there is a Fraction in the Diviſion, it may be reduced to Feet and Inches; 6 Feet being a Fathom, and 12 Inches a Foot.

A TABLE *shewing the Weight of any Cable or Rope of* 120 *Fathom in Length, and for every half Inch from* 3 *Inches to* 24 *in Circumference.*

I.	C.	Q.	I.	C.	Q.
3	2	1	14	49	0
3½	3	0	14½	52	2
4	4	0	15	56	1
4½	5	0	15½	60	0
5	6	1	16	64	0
5½	7	2	16½	68	0
6	9	0	17	72	1
6½	10	2	17½	76	2
7	12	1	18	81	0
7½	14	0	18½	85	2
8	16	0	19	90	1
8½	18	0	19½	95	0
9	20	1	20	100	0
9½	22	2	20½	105	0
10	25	0	21	110	1
10½	27	2	21½	115	2
11	30	1	22	121	0
11½	33	0	22½	126	2
12	36	0	23	132	1
12½	39	0	23½	138	0
13	42	1	24	144	0
13½	45	2			

I chose to instance in a Cable of the Length abovementioned, because Yarn set at 200 Fathom, will, in the laying of a Cable, work up or shorten to 120 Fathom; Cable-laid Ropes working in about two Parts in five; but if it is a half Cable, or a Part of a Cable of any other Length, the Weight of 120 Fathom being found by the Table, the Weight of any lesser Part is easily found in Proportion to its Length.

The

The Uſe of the TABLE.

THE firſt Column marked *I.* for *Inches*, is the Thickneſs or Circumference of the Cable to every half Inch from 3 to 24; the ſecond and third, marked *C. Q.* for *Hundreds* and *Quarters*, are the Hundreds and Quarters that it will weigh if 120 Fathom in Length. As for Inſtance, ſuppoſe a Cable of fourteen Inches and an half; look againſt 14½ in the fourth Column, and you find againſt it in the other Columns 52|2; which ſhews that 120 Fathom of Cable of 14 Inches and an half about, will weigh 52 Hundred 2 Quarters, or 52 Hundred and an half; and ſo in others. And any of a leſſer Length will weigh in Proportion.

The Conſtruction of this Table is from hence, that as all Cables are ſolid Bodies, and may properly come under the Denomination of Cylinders; and as ſuch, the Weight of Cables of any determinate Length, will be in proportion to the Squares of their Circumferences. From this Foundation, Experience has formed this general brief Rule, *viz. Multiply the Thickneſs of the Cable by itſelf, and one Fourth of that Product is the Weight of* 120 *Fathom.* As for Inſtance; ſuppoſe a Cable of 12 Inches, 12 times 12 is 144, the Quarter of which is 36, the Weight of 120 Fathom of a Cable of 12 Inches; as you ſee in the Table.

Note, This Table gives the utmoſt Weight of Cables of the Length and Size propoſed, and ſomething, tho' inconſiderably, differs from the foregoing. As for Inſtance; in the foregoing Table 6 Fathom of a 9 Inch Rope makes an Hundred Weight, and conſequently 120 Fathom ſhould be juſt 20 Hundred Weight, but in this it makes 20 Hundred and 1 Quarter; but the Difference is inconſiderable, and the Cables never exceed the Weight here propoſed.

The following Rule serves to find the Tunnage, as practised now by Ship-Builders, when the Ship is afloat, and the Length of the Keel cannot be duly taken by Mensuration.

RULE.

FROM the extreme Length, subtract three Fifths of the extreme Breadth, the Remainder is the Length of the Keel; then, multiply the length of the Keel by the extreme Breadth, and that Product by the half Breadth, which last divide by 94 for Merchant-ships, and by 100 for Men of War, gives the Tuns and 94th or one Hundred Parts of a Tun.

Note, Always reduce your Inches, *&c.* into the Decimals of a Foot.

EXAMPLE.

A Ship, whose extreme Length is = 100 Feet 1½ Inch, extreme Breadth = 29 Feet 3 Inches, what is her Tunnage?

Feet.

Extr. Len. in Dec. =100.125
Sub. ⅗ of Extr. Br. - - - = 17.55
Len. of the Keel - - - - - = 82.575
Mult. by Extr. Br. - - - = 29 25

412875
165150

743175
165150

2415.31875

Mult. by ½ Extr. Br. - - - = 14.625

1207659375
483063750
144919125
96612750
24153187

Tuns

94|35324.03671875 (375 19/94 for Merchant-service.
712
544
74

the rem. Dec. are of very little Value.

Tuns.

100) 353|24. - - = 353 24/100 for Men of War.

Feet. Feet. Feet.

Extr. Br. = 29.25. ½ Br. = 14.625

3

5)87.75(0

17.55 = ⅗ of Ex. Br.

Di-

DIRECTIONS *for cutting out Sails.*

HAving made a Scale, by which the Length of the Keel, *&c.* is laid down, as at the Beginning hereof, you may obſerve the following Directions.

Fix two Yards, the one hoiſted, the other lowered, or a Portlings; the Top-ſail Yard alſo, the one hoiſted, the other down upon the Cap, and thus muſt you do in all the Models you raiſe.

The Yard a Portlings gives the Length of the Top-ſail Sheets, Lifts, Tye or Jeers, Bunt-lines, and Leech-lines or Hallyards, meaſuring from the Hounds to the Deck.

The Yards hoiſted gives the Length of the Clue-lines, Braces, Clue-garnets, Jacks, Sheets, and Bow-lines.

You may alſo find the length of the Shrouds, Top-ſail Hallyards, Braces, and Lifts.

You may alſo, from a Model thus raiſed, give a near Eſtimation how many Yards of Canvas is in a main Courſe. *Note*, When you come into any Ship or Veſſel, and deſire to know how many Yards of Canvas are in the Main or Fore Courſe: Firſt, find the Depth of your Sail, and the Breadth of the Canvas made uſe of, then take off ſo much from the Scale as you ſee the Cloth is in Breadth, and place ſo many Cloths in the Model, on the Main or Fore Yard, the ſame Depth that the Sail is on. After you have ſo done, take a Fathom or two off from your Scale, and meaſure every Cloth up and down, as you do the Ropes, and that will give you the Yards.

You may alſo, from ſuch a Model, find the Number of Yards that are in the Main or Fore Top-ſail: The ſame way you meaſure one Sail, you meaſure all.

But you muſt obſerve, that you are to place the middle Cloth firſt in a Top-ſail, and ſo from thence to each Yard-arm, that your Gores at the Clue may fall out right.

It likewiſe ſheweth the Length of the Main-top-ſail Bow-lines, and of the Fore-top-ſail Bow-lines. Draw only a Line from the Top-ſail Yard-arm, to the Main Yard-arm, with Ink or Black-lead. *Note*, From the further Yard-arm, that you may take them at the largeſt Extent, and ſo your Braces. You alſo have the length of the Main Bow-line, Main Sheet, Main Jack, and ſingle Garnet.

As for Braces, draw a Line from the Yard-arm to the Place where the Brace ſhould go: You may draw it double, if you pleaſe, as the Braces

Braces go; or you may draw but one ſingle Line, and ſo [illegible] Fathom off from your Scale, and where it goes double, tell two Fathom, where Single tell but one.

And for the Fore-top-ſail Sheets, draw a Line from the Top-ſail Yard that is upon the Cap, down to the Yard-arm that is a Portlings; then take one Fathom or two off your Scale, and meaſure from the Top-ſail Yard to the Fore Yard upon the Line that you have drawn, and then from the Fore-yard-arm to the Maſt, and ſo down to the Forecaſtle, and there you have the juſt Length of your Top-ſail Sheets, and it is left to your Diſcretion what Stay you will allow: So likewiſe you muſt do for your Main-top-ſail Sheet, Fore-top-gallant Clue-lines, and Top-ſail Clue-lines; as alſo for any Ropes whatſoever, drawing the Lines, and meaſuring their Lengths.

But *Note*, That when you meaſure the Stays, you muſt meaſure the Collar firſt double three or four Fathom, according as your Model requires it; for as it becomes the Model, ſo it will appear upon the Veſſel; and obſerve that the Collar belongs to the Length of the Stay.

But for the Pendants of the Braces, you muſt meaſure them firſt three, or two Fathom, as you ſee it will become the Model, there mark the Block, and ſo meaſure the Length of the Brace from that.

F I N I S.