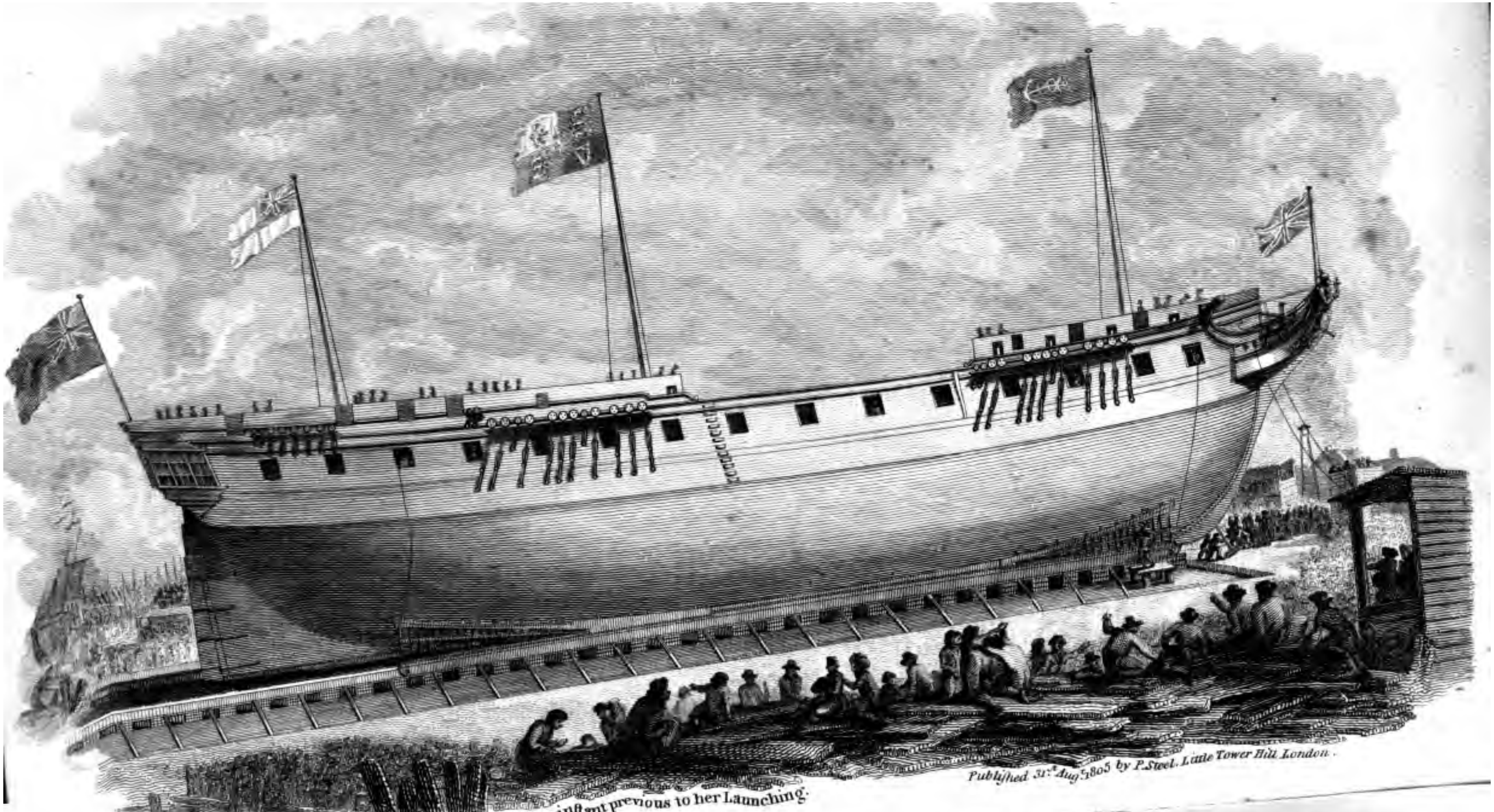

Published 31st Aug. 1805 by P. Steel, Little Tower Hill London.

Representation of a 40-Gun Frigate, at the instant previous to her Launching.

THE

SHIPWRIGHT's

VADE-MECUM:

A CLEAR AND FAMILIAR INTRODUCTION

TO THE

PRINCIPLES AND PRACTICE

OF

SHIP-BUILDING:

INCLUDING THE MORE COMPLEX

RULES OF ARITHMETIC MADE USE OF IN THAT ART;

WITH SO MUCH OF THE PRINCIPLES OF

PRACTICAL GEOMETRY AND MENSURATION

AS ARE REQUIRED IN THE PRACTICE THEREOF.

ALSO,

A DESCRIPTION OF THE SLIDING RULE;

RULES FOR THE

ADMEASUREMENT OF TIMBER;

WITH

SEVERAL USEFUL TABLES, AND TABLES OF DIMENSIONS, &c.

ILLUSTRATED WITH

FOUR LARGE ACCURATE DRAUGHTS,

FITTED UP SEPARATELY, AND NUMEROUS SMALLER FIGURES.

LONDON:

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PREFACE.

Naval Architecture, whether it be considered abstractedly, or as the foundation of all Marine Science, is justly entitled to our admiration and regard, from the eminent utility of the knowledge derived from its study.

The national importance of this noble art, from the earliest ages, but particularly at the present crisis of affairs, obviates the necessity of diffuse comment.

This subject has not, until very lately, been treated of with a precision or extent adequate to its present state of improvement.

A work that comprehends it fully, necessarily requires numerous draughts, on a large scale, for its elucidation; which also demand copious explanations to render them intelligible. Consequently, such a work becomes of magnitude, both in size and price: the expense of several being considerable, which merely treat the subject *partially*.

The scale on which preceding works have been executed was either too large or too small for the gene rality of readers; and the smaller introductions, in particular, were so grossly defective and erroneous, as to have excited the contempt even of novices in the art.

"The Elements and Practice of Naval Architecture," 4to, a large and elegant work, has been, from these circumstances, presented to the public, since the commencement of the present year; which embraces, within its ample limits, a full and accurate detail of all the particulars requisite for a complete knowledge of Ship-Building.

This work has already been honoured with the most flattering testimonials of public approbation*; and is calculated to facilitate the attainment, and develope the most complex operations, of the science, to the most common capacity.

But, the price, inevitably attendant on the extensive intelligence therein contained, is too high for the circumstances of many who would doubtless be highly gratified with the perusal of its valuable contents.

This consideration suggested the idea of the present volume, and induced the Proprietor to sacrifice individual emolument to public benefit; who has accordingly endeavoured to render the purchase of this volume compatible with the resources of the professional class, for which it is more peculiarly intended.

* An abstract of the contents of this work may be seen at the end of the present volume.

The ultimate object of the Editors has been to comprise, in a separate and cheaper form, so much upon the *practical* parts of Ship-Building, as might be convenient for permanent reference to carpenters at sea, and young men first entering on the practice of the art.

Every attention has been bestowed to render the execution of the present work consistent with the accomplishment of this immediate view.

And it will be found, that the subjects are discussed more fully and accurately, than the size of the volume may seem to promise.

The Arithmetic, Geometry, and Mensuration, are given clearly, though concisely, nor, it is hoped, has any thing been omitted, tending to the convenience of those whose accommodation has been more expressly regarded.

When the young artist is tolerably well acquainted with the contents of the following sheets, he will undoubtedly be anxious to become acquainted with the grand business of the Mould-Loft; without which, he cannot expect to reach the primary object of all his hopes—eminence in his profession. To effect this purpose, he will find himself under the necessity of refering to the larger work; and, it is presumed, he will find reason to congratulate himself on having acquired, by his purchase, not only the desired information, but also a large Set of Draughts, an extensive Set of Tables, equally accurate and valuable, and a knowledge of theoretic principles: the practical utility of which will accompany him through life.

It may not be deemed irrelevant to add that, in the two works, the matter has been considerably *varied;* and that, *the draughts given in the one are not repeated in the other.*

Either, therefore, will form a proper companion to the other; while the smaller work may be occasionally consulted, and will thus conduce to the preservation of the larger.

The decision of the Public must determine the degree of merit with which the original idea has been carried into effect.

The Proprietor, in reflecting on the encouragement with which the 4to edition has already been favoured, although the short space only of four months has elapsed from its first publication, is emboldened to entertain the pleasing presentiment, that this succeeding attempt will not be deemed unworthy of similar patronage by candid and competent judges.

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ARITHMETICAL SIGNS AND CONTRACTIONS

MADE USE OF IN THE PRESENT WORK.

$=$	signifies	is equal to.
$\times$		multiply by.
$\div$		divided by.
$-$		*minus*, or subtract.
$+$		*plus*, or add.
$:$		as, &c. is or are to } i. e. proportion.
$::$		so, &c. is or are to } i. e. proportion.
2^2		square of 2.
$2^3, 2^4, 2^5$		cube, 4th power, 5th power, &c. of 2.
$\sqrt[2]{2}$		square root of 2.
$\sqrt[3]{2}$		cube root of 2.
$\sqrt[4]{2}$		4th root of 2, &c.

*** *The Reader is particularly requested to attend to the Errata, &c. at the End of the Volume.*

INTRODUCTION.

SECTION I.

OF ARITHMETIC.

THE first rudiments of ship-building have their foundation in the principles of arithmetic and practical geometry; it is therefore proper that this treatise should commence with an explanation of these sciences. It is, however, to be presumed, that every young artist, before he proceeds to the study of the art of ship-building, will, at least, have acquired a competent knowledge of the fundamental rules of common arithmetic; hence it would be superfluous to explain them here: we shall, consequently proceed, in the first instance, briefly to explain the more complex rules, particularly proportion, vulgar and decimal fractions, the extraction of roots, &c. commencing with,

PROPORTION IN GENERAL.

By *proportion* is meant that analogy or relation which two or more numbers have to each other, with respect to their comparative or relative values; and by which, when compounded together, those values may be ascertained.

In a proportional statement of two numbers, the number first written is called the *antecedent;* the latter the *consequent;* and the antecedent is compared with the consequent, to form a comparison.

Arithmetical progression consists in the difference between the antecedent and consequent being always the same, through a series of numbers.

Geometrical progression considers the *quotient* of the two numbers, which is called the geometrical ratio. Thus, 4, 3, 2, 1, are in arithmetical progression, the constant difference being 1: but 4, 8, 16, 32, &c. are in geometrical progression, because the quotient produced by the division of any one of these numbers by another (provided the divisor be less) is 2; the number 2, therefore, is the geometrical ratio.

When all the greater or inferior terms of two or more couplets of numbers are similarly stated, that is, when all of one sort are taken as antecedents, and the other as consequents; if the ratio or difference of each couplet be the same, the couplets are said to be in proportion; and their terms are called proportionals. Thus in the two couplets 4, 6, and 8, 10, if they are placed thus, 4, 6, 8, 10, or thus, 6, 4, 10, 8, they are arithmetical proportionals—and if the two couplets 4, 8, 16, 32, be taken thus, 4, 8, 16, 32, or thus, 8, 4, 32, 16—they are geometrical proportionals.

Proportion may be divided into continued and discontinued.

If the difference or ratio of the consequent of one couplet, and the antecedent of the succeeding one be the same as the common difference or ratio of the couplets, the proportion is continued; if not, it is *discontinued.* Thus, 4, 6, 8, 10, form a continued arithmetical progression, because the common difference is 2, and 6—8=2. Also the couplets 4, 8, 16, 32, &c. form a continued geometrical progression, because $\frac{8}{4}=2$, $\frac{16}{8}=2$, &c. the ratio being 2.

But 6, 4, 10, 8, are in discontinued arithmetical proportion, &c. 8, 4, 32, 16, are in discontinued geometrical proportion, because the ratio in both cases is two, but 10—4=6, and 32÷4=8.

When the terms gradually increase, the series is called *ascending*; when they decrease, *descending*.

To denote geometrical proportion, the couplets are separated by a double colon : :—and a colon is written between the terms of each couplet. Thus, 4 : 8 : : 16 : 32; that is to say, as 4 is to 8, so is 16 to 32.

OF ARITHMETICAL PROGRESSION.

Arithmetical progression is the augmentation or diminution of any series of numbers, by the addition or subtraction of an equal difference.

Thus, 2, 4, 6, 8, 10, are numbers in arithmetical progression increasing by 2; and 100, 96, 92, 88, 84, 80, 76, 72, &c. are in arithmetical progression, decreasing by 4.

PROPOSITION I.

To find the sum of the series, multiply the sum of the extremes by half the number of terms. The product will be the answer.

Example 1. The sum of a number of terms, increasing by 3, the extremes being 1 and 25?

Here it is evident, that as the difference between 1 and 25 is 24, and the common difference 3, as 24÷3=8, the number of terms must be equal to 8+the 1st term (1); i. e. the number of terms=9.

Sum of 1+25=26.

$26 \times 4\frac{1}{2}=117$ the Answer.

Example 2. What is the sum of the number of times that a clock strikes between the hours of 2 and 12.

The first term=3; the last term=12; the common difference 1—the number of terms=10.

3+12=15. $15 \times 5=75$ the Answer.

PROPOSITION II.

Given one of the extremes, the common difference, and the number of terms, to find the other extreme.

Rule. Multiply the common difference by one less than the number of terms; then add the product to the first term, to find the greatest extreme; or deduct it from the largest extreme to find the least.

The largest extreme is required of a number whose other extreme is 5, the number of terms 10, and the common difference 2?

$2\times 9=18$. $18+5=23$ the Answer.

The smallest extreme is required of a number whose greatest term is 103; the common difference 4, the number of terms 25.

$4\times 24=96$. $103-96=7$ the Answer.

PROPOSITION III.

Given the extremes and common difference, to find the number of terms.

Deduct the lesser extreme from the greater, divide by the common difference, add 1 to the quotient. The sum is the Answer.

Extremes 48 and 152. Common difference 4. Required number of terms?

$152-48=104$.

$104\div 4=26$. $26+1=27$ the Answer.

PROPOSITION IV.

Given the extremes and number of terms to find the common difference.

Deduct the lesser extreme from the greater.

Divide the difference by the number of terms -1. The quotient is the common difference.

Example. The 2 extremes 589 and 1093; the number of terms $=127$. Required the common difference?

$1093-589=504$. $504\div 126=4$ the common difference.

OF GEOMETRICAL PROGRESSION.

A Geometrical Progression is a series of numbers, increasing or decreasing by a given proportion, so that each term divided by its preceding one will produce the same quotient that is given by the division of a number, to which the afore-mentioned term is the divisor, and the next adjacent *increasing* or decreasing term the dividend. Thus,

2 : 4 : : 8 : 16 : : 32 : 64 : : 128, &c.

$8\div 4$ produces the same quotient or common ratio, as $16\div 8$, &c.

32 : 16 : : 8 : 4, &c.

$16\div 8$ gives 2; as also 8 by 4, &c.

PROPOSITION I.

To find the sum of the series.

Divide the difference of the extremes by the ratio less 1.

Add to the quotient the greater extreme.

The sum is the sum of the series.

Example. The lesser extreme being 2, the larger 256, the ratio 2, required the sum of the series?

2 : 4 : : 8 : 16 : : 32 : 64 : : 128 : 256 : : the number of terms $=8$.

Difference of the extremes$=254$. $254 \div 1 = 254$. $254+256=510$, sum of the series.

PROPOSITION II.

To find the greater extreme; given, the ratio, one extreme, and the number of terms.

RULE. Multiply the ratio into itself a number of times less by one than the number of terms. Divide the greater extreme by the product, to find the least term; and multiply the inferior extreme by it to find the greatest term.

EXAMPLE. The smallest term being 1, the ratio 3, and the number of terms 8, required the greatest extreme?

3 multiplied into itself 7 times$=2187$. $2187 \times 1 = 2187$, the Answer.

PROPOSITION III.

Given the extremes and ratio, to find the number of terms.

RULE. Divide the greatest extreme by the least term; divide the quotient by the ratio, till it is equal to it; add two to the number of times that the aforesaid quotient has been divided. The sum will be the number of terms.

EXAMPLE. Extremes, 3 and 2187; ratio, 3; required the number of terms?

$2187 \div 3 = 729$. $729 \div 3$, five times,$=3.5+2=7$ the Answer.

VULGAR FRACTIONS.

1. A VULGAR FRACTION is a part of an integer, or 1; if less than an integer, it is *proper;* if equal to, or exceeding it, *improper.*

2. Every fraction consists of two terms; the upper one, signifying the number of the parts of the denominator contained in the fraction, is called the *numerator;* the lower one, *denoting* the number of parts into which the integer is divided, is called the *denominator.*

3. The value of every fraction is equal to its numerator divided by the denominator; consequently the numerator is the dividend, and the denominator the divisor.

Thus, 3 is the numerator of the fraction $\frac{3}{4}$, and 4 its denominator; as the numerator 3 is less than the denominator 4, $\frac{3}{4}$ is a *proper* fraction, i. e. less than 1; and its value is equal to 3 divided by 4. $\frac{7}{6}$ is an *improper* fraction.

4. A *simple* fraction consists of one upper and one lower number; a *compound* one, or fraction of a fraction, consists of two or more simple fractions linked together by the word of; thus $\frac{2}{3}$ *of* $\frac{5}{6}$ *of* $\frac{7}{11}$ is a *compound* fraction.

5. A mixed number is a whole number, and a fraction joined; as, $3\frac{3}{8}$, $4\frac{5}{7}$, $8\frac{3}{4}$.

6. *Denomination* of an integer is the name of an integer; therefore, the denomination pence is lower than shillings; shillings lower than pounds, &c. and so with respect to measures, weights, coins, &c.

7. The greater the denominator is, the less is the fraction; and, *vice versá*.

8. When the numerator and denominator are equal, the value of the fraction is 1; thus $\frac{6}{6}=1$.

9. When a line is drawn between two fractions, it signifies, that the upper fraction is to be divided by the lower one; thus, $\dfrac{\frac{5}{6}}{\frac{8}{9}}$ denotes, that $\frac{5}{6}$ are to be divided by $\frac{8}{9}$, the method of finding the value $(=\frac{20}{27})$ will be shewn hereafter.

REDUCTION OF VULGAR FRACTIONS.

Case 1. To reduce a simple fraction into another of equal value.

Rule. Multiply or divide both the numerator and the denominator by the same number, the *product*, or *quotient*, will be the Answer.

Example. Reduce $\frac{5}{8}$ to a fraction of equal value.

$\frac{5}{8}\times 5=\frac{25}{40}$. $\frac{5}{8}\times 2=\frac{10}{16}$.

Example. Reduce $\frac{10}{9}$ to a fraction of equal value.

$10\times 2=20$. $9\times 2=18$.

Answer $\frac{18}{20}$.

Example 2. Reduce $\frac{54}{162}$ to a fraction of equal value.

$54\div 3=18$. $18\div 3=6$. $6\div 3=2$. $162\div 3=54$. $54\div 3=18$. $18\div 3=6$.

162 having been divided the same number of times as the numerator 54; the Answer is found to be $\frac{2}{6}$ or $\frac{1}{3}$.

Case 2. To reduce fractions of different denominations to others of the same denominator, and equal value.

Rule. Multiply *successively* all the numerators by every denominator but its own; and all the denominators together for a new denominator.

Example 1. Given $\frac{5}{8}$ and $\frac{4}{7}$.

$5\times 7=35$. $4\times 8=32$. *Denom.* $7\times 8=56$. Answer $\frac{35}{56}$ and $\frac{32}{56}$.

Example 2. Given $\frac{20}{27}$, $\frac{9}{7}$, $\frac{10}{9}$, $\frac{4}{3}$, $\frac{18}{25}$, $\frac{49}{57}$.

$20\times 7\times 9\times 3\times 25\times 57=5386500$.

$9\times 27\times 9\times 3\times 25\times 57=9349425$.

$10\times 27\times 7\times 3\times 25\times 57=8079750$.

$4\times 27\times 7\times 9\times 25\times 57=9709950$.

$18\times 27\times 7\times 9\times 3\times 57=4807026$.

$49\times 27\times 7\times 9\times 3\times 25=6251175$.

$27\times 7\times 9\times 3\times 25\times 57=$ the common denominator, 7271775.

Answer $\frac{5386500}{7271775}$, $\frac{9349425}{7271775}$, $\frac{8079750}{7271775}$, $\frac{9709950}{7271775}$, $\frac{4807026}{7271775}$, $\frac{6251175}{7271775}$.

Case 3. To reduce a whole number to an improper fraction of a given denominator.

RULE. Multiply the given number by the given denominator: place the denominator under the product.

EXAMPLE 1. Reduce 48 to an improper fraction, the denominator of which shall be 8.

$$48 \times 8 = 384$$

Answer $\frac{384}{8}$.

EXAMPLE 2. Given the number $7\frac{3}{4}$ and the denominator 12.

$$7\tfrac{3}{4} \times 12 = 93$$

Answer $\frac{93}{12}$.

CASE 4. To reduce a compound fraction into a simple fraction.

RULE. Multiply all the numerators and denominators together.

EXAMPLE 1. Given $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{10}{7}$ of $\frac{9}{13}$.

$2 \times 3 \times 10 \times 9 =$ Numerator 540.

$3 \times 4 \times 7 \times 13 =$ Denominator 1092.

Answer $\frac{540}{1092}$.

CASE 5. To reduce a mixt number to an improper fraction, and an improper fraction to a mixt number.

RULE. To find the improper fraction, multiply the whole number by the denominator of the fraction adjoined; to the product add the numerator of the adjoined fraction; the sum, with the denominator of the adjoined fraction placed beneath it, will be the improper fraction. To find the mixt number, divide the numerator by the denominator; and place the remainder, if any, over the denominator. This *proper* fraction and the *whole* number already found = the Answer.

EXAMPLE 1. Reduce $9\frac{7}{8}$ to an improper fraction.

$9 \times 8 = 72$. $72 + 7 = 79$. $79 \div 8$.

Answer $\frac{79}{8}$.

EXAMPLE 2. Reduce $51\frac{9}{13}$ to an improper fraction.

$51 \times 13 = 663$. $663 + 9 = 672$. $672 \div 13$.

Answer $\frac{672}{13}$.

EXAMPLE 3. Reduce $\frac{679}{48}$ to a mixt number.

$679 \div 48 = 14$, and 7 remainder.

Answer $14\frac{7}{48}$.

EXAMPLE 4. Reduce $\frac{51}{11}$ to a mixt number.

$51 \div 11 = 4$, and 7 remainder.

Answer $4\frac{7}{11}$.

CASE 6. To reduce a fraction to its lowest terms.

RULE. Find the greatest common measure of the numerator and denominator; and the quotient will be equal to the fraction in its lowest terms. In order to find the greatest common measure, divide the greater number by the lesser, and the last divisor by the remainder till there is no remainder; the *last divisor* will be the greatest common measure.

Example 1. Reduce the fraction $\frac{4418}{9767}$ to its lowest terms.

9767÷4418=2, remainder 931. 4418÷931=4, remainder 694. 931÷694=1, remainder 237. 694÷237=2, remainder 220. 237÷220 =1, 17 remainder. 220÷17=12, 16 remainder. 17÷16=1, 1 remainder. 16÷1=16, no remainder. 1 being the greatest common measure, the fraction is already in its lowest terms.

Example 2. Reduce $\frac{126}{216}$ to its lowest terms.

216÷126=1, remainder 90. 126÷90=1, remainder 36. 90÷36=2, remainder 18. 36÷18=2, no remainder. Last divisor 18.

Divide $\frac{126}{216}$ by 18=$\frac{7}{12}$ the answer.

Case 7. To find the proportion that fractions bear to each other in integers.

Rule. Find a common denominator; divide it by the denominator, and multiply it by the numerators of all the fractions. The products will represent the proportion they bear to each other.

Example 1. What proportion do $\frac{5}{7}$, $\frac{7}{9}$, and $\frac{9}{11}$ bear to each other?

7×9×11=693, the common denominator.

$\frac{5}{7}$ of 693=495. $\frac{7}{9}$ of 693=539. $\frac{9}{11}$ of 693=567.

The proportion, therefore, that the three fractions bear to each other is 495, 539, 567.

Case 8. To find the value of a fraction in the parts of its integer.

Rule. Multiply the numerator by the *first* parts of the integer, and divide by the denominator. The *quotient* will be the number of *first* parts. If there be any remainder, multiply it by the number of *second* parts and divide by the denominator. So proceed.

What is the value of $\frac{9}{11}$ of a pound sterling?

9×20=180.
180÷11=16 shillings. Remainder 4.
4×12 pence=48.
48÷11=4 pence. Remainder 4*d.*
4×4 farthings=16.
16÷11=1 farthing. Remainder 5.

Answer 16*s.* 4¼*d.*

Case 9. To reduce a fraction to one of a greater or lesser denomination.

Rule. If of a greater denomination, multiply the denominator by the number of times that the greater denomination exceeds the inferior one. If it is to be reduced from a greater to a lesser denomination, divide the denominator by the number of times that the greater denomination exceeds the inferior one.

Example 1. What part of a pound are three farthings?

In a pound, nine hundred and sixty farthings are contained.

4×960=3840.

Answer $\frac{3}{3840}$.

Example 2. What proportion does ½ an *oz.* bear to a *lb.* avoirdupois?

A *lb.* contains 16 *oz.* 2×16=32 or $\frac{1}{32}$, the Answer.

CASE 10. To reduce a fraction into another of equal value, of a given denominator.

RULE. Multiply the numerator by the given denominator, and divide the product by the denominator of the given fraction. The quotient will be the numerator required.

EXAMPLE. Reduce $\frac{7}{9}$ to a fraction whose denominator shall be 63.

$63\times 7=441$. $441\div 9=49$ the numerator required.

Answer $\frac{49}{63}$.

CASE 11. To reduce a fraction into another of equal value, with a given numerator.

RULE. Multiply the given numerator and the denominator together; divide by the first numerator. The quotient is the denominator required.

EXAMPLE. Reduce $\frac{7}{13}$ to a fraction whose numerator shall be 19.

$19\times 13=247$. $247\div 7=35$. $\frac{2}{7}$ the denominator required.

Answer $\frac{19}{35}$, $\frac{2}{7}$.

ADDITION OF VULGAR FRACTIONS.

REDUCE *mixt* numbers into improper fractions, compound fractions to simple ones, and all to one common denominator. Add all the numerators together, and under their sum place the common denominator. The fraction thus produced will be the Answer.

EXAMPLE 1. Add together $\frac{5}{9}$, $\frac{4}{7}$, $\frac{8}{13}$, $\frac{11}{19}$, $\frac{30}{54}$.

$9\times 7\times 13\times 19\times 54=$ the common denominator 840294.

Proceed as in Case 2, and the numerators will be found to be 466830, 480168, 517104, 486486, 466830.

$$\begin{array}{r} 466830 \\ 480168 \\ 517104 \\ 486486 \\ 466830 \\ \hline 2417418 \end{array}$$

Answer $\frac{2417418}{840294}$.

EXAMPLE 2. Add $3\frac{7}{9}$, $9\frac{5}{8}$, and $\frac{10}{4}$ together.

The common denominator is 288, the numerators 1088, 2772, and 724.

$1088+2772+724=4584$.

Answer $\frac{4584}{288}$, or the mixed number $15\frac{11}{12}$.

SUBTRACTION OF VULGAR FRACTIONS.

Rule. Proceed as in the foregoing rule; then subtract the lesser numerator from the greater; and subjoin the common denominator, as found by Case 2, to the difference.

Example. Subtract the sum of $9\frac{7}{8}$, $5\frac{2}{9}$, $11\frac{10}{19}$, from $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{8}$ of the sum of $10\frac{5}{8}$, $11\frac{9}{11}$, and $12\frac{13}{14}$. The sum of $9\frac{7}{8}$, $5\frac{2}{9}$, and $11\frac{10}{19}$, by the preceding rules$=\frac{36421}{1368}$. The sum of $10\frac{5}{8}$, $11\frac{9}{11}$, and $12\frac{13}{14}=\frac{43578}{1232}$. $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{8}$ multiplied together, give $\frac{30}{96}$ or $\frac{5}{16}$. $\frac{5}{16}$ of $\frac{43578}{1232}=\frac{217890}{19712}$, consequently, of the two numbers $\frac{36421}{1368}$ and $\frac{217890}{19712}$, the inferior is to be subtracted from the superior. Reduced to a common denominator, they stand as follow; $\frac{717930752}{26966016}$, and $\frac{298073520}{26966016}$.

From ..	717930752
Deduct	298073520
	419857232

Answer $\frac{419857232}{26966016}$.

From the above example, it will be easy to answer any other question proposed.

MULTIPLICATION OF VULGAR FRACTIONS.

Rule. Proceed as in the foregoing rules, and multiply the numerators and denominators into each other. The product will be the Answer.

Example. Multiply $51\frac{19}{35}$, by $48\frac{99}{125}$. $51\frac{19}{35}=\frac{1804}{35}$; and $48\frac{99}{125}$ to $\frac{6099}{125}$.

$6099\times1804=11002596$. $125\times35=4375$. $11002596\div4375=2501$, $\frac{2221}{4375}$.

DIVISION OF VULGAR FRACTIONS.

Rule. Proceed as before directed; then, multiply the denominator of the divisor by the numerator of the dividend, for the numerator of the quotient; and multiply the numerator of the divisor by the denominator of the dividend for the denominator of the quotient.

The two products will constitute the fraction required.

Example. Divide $10\frac{19}{24}$ by $5\frac{18}{45}$.

$\frac{259}{24}$ and $\frac{243}{45}$ reduced to an equal denominator $\frac{11655}{1080}$ and $\frac{5832}{1080}$.

$1{\cdot}1655\times1080=12587400$. $5832\times1080=6298560$.

Answer $\frac{6298560}{12587400}$.

DECIMALS.

A DECIMAL is a fraction whose denominator is 10, 100, 1000, &c. &c.

The Decimals are placed to the right hand of the Integers; being separated from them by a dot. Any number of cyphers, being placed to the right hand of a decimal, does not alter its value; but every other figure placed to the right, is worth only one tenth of what it would be, were it one place farther to the left.

Thus .1 signifies one tenth.
.11 eleven hundredths.
.112 one hundred and twelve thousandths.

The denominator being always of that class of numbers, produced by the multiplication of the numerator by 10. Thus, as 1 multiplied by 10 gives 10, the denominator is 10; 112 being multiplied by 10 gives 1120, *i. e.* thousandths, consequently the denominator is 1000, &c. &c.

A mixt decimal is an integer and a decimal united; as, 3.1457.

A circulating decimal is one whose value cannot be accurately expressed by any vulgar fractions. Thus 3333, &c. cannot be expressed *accurately* by any fraction; it is nearly equal to $\frac{1}{3}$. The reason is obvious: for 10 divided by 3 quotes 3 and a remainder of 1. As the deficiency of figures must be supplied by cyphers, 1000, &c. divided by 3 will produce nothing but a continual series of 333, &c. should the operation be carried on to infinity.

Therefore, some vulgar fractions cannot be correctly expressed in decimals. From what has been said, it is evident that decimal figures decrease in value from left to right, and *vice versâ.*

ADDITION OF DECIMALS.

RULE. Place tens under tens, hundreds under hundreds, &c. Then sum up as in whole numbers, and separate the integers from the decimals by a dot.

EXAMPLE. Add together 10.257, 5.393, 4.937, 3.873, 2.92.

$$\begin{array}{r} 10.257 \\ 5.393 \\ 4.937 \\ 3.873 \\ 2.920 \\ \hline 27.380 \end{array}$$

Sum.

SUBTRACTION OF DECIMALS.

Rule. Proceed as in the preceding rule, then subtract, as in whole numbers.

Example. Subtract 10.579863599 from 21.876897894.

```
 21.876897894
 10.579863599
 ------------
 11.297034295  Answer.
```

MULTIPLICATION OF DECIMALS.

Rule. Multiply as in whole numbers; and cut off as many figures from the product, proceeding from right to left, for decimals, as there are decimal figures in the multiplier and multiplicand.

Example. Multiply 13.59876 by 15.58797.

```
       13.59876
       15.58797
   ------------
        9519132
      12238884
      9519132
    10879008
    6799380
   6799380
  1359876
 --------------
 211.9770629172
```

As there are 5 places of decimals in the dividend, and 5 in the divisor, cut off 10 figures from the product.

Answer 211.9770629172.

DIVISION OF DECIMALS.

Rule. Divide as in whole numbers; then cut off, as before, as many places from the quotient, as the decimal places in the dividend exceed those in the divisor. If there is a deficiency of figures in the dividend, add cyphers.

Example. Divide 161.57 by 21.573.

```
21.573)161.57000000(7.48945
       151011
       ------
       105590
        86292
       ------
       192980
       172584
       ------
        203960
        194157
        ------
         098030
          86292
         ------
          117380
          107865
          ------
            9515
```

The decimal places in the dividend are 8, in the divisor 3; mark off 5 figures from the quotient. Answer 7.48945.

REDUCTION OF DECIMALS.

CASE 1. To reduce a vulgar fraction to a decimal fraction of nearly equal value.

RULE. Add cyphers to the numerator; and divide by the denominator. The quotient is the decimal required. If cyphers may be added *ad infinitum*, without producing an *exact* quotient, the decimal is a circulating one.

EXAMPLE 1. Reduce $\frac{11}{12}$ to a decimal.

```
12)1100000000000
   -------------
   .9166666666, &c. Answer.
```

The above is a circulating decimal.

EXAMPLE 2. Reduce $\frac{15}{16}$ to a decimal.

```
16)150000
   ------
   .9375 Answer.
```

EXAMPLE 3. Reduce $\frac{31}{32}$ to a decimal.

```
32)3100000
   -------
   .96875 Answer.
```

CASE 2. To find the value of a decimal fraction of a pound, or any other denomination.

Rule. Multiply the decimal successively by the different component parts from the highest to the lowest.

Example 1. What is the value of .76 of a pound sterling?

76
20
15.20
12
2.40
4
1.60 Answer 15*s.* 2¼*d.*

Example 2. What is the value of .96 of a lb. avoirdupois?

.96
16 oz.
15.36
20 pennyweights.
7.20
24 grains
4.80 Answer 15 oz. 7 dwts. 4 gr.

Example 3. How many feet in length is the decimal .553 of a pole?
A pole=16½ feet.

.553
16½
9.324½
12 inches
3.894
3 barley corns
2.682 Answer 9 ft. 3 inc. $\frac{2}{3}$.

Case 3. To reduce the known parts of an integer to a decimal.

Rule. Form a vulgar fraction, the denominator of which shall be the number of times that the lowest denomination in the known parts to be reduced, is contained in the integer: the numerator will be the *number* of the lowest denomination contained in the known parts to be reduced.

Example 1. What part of a pound sterling is 1*s.* 5¾*d.*?

In a pound are 960 farthings; and in 1*s.* 5¾*d.* are contained 71 farthings; consequently the vulgar fraction is $\frac{71}{960}$.

960)71000000000
.739583333, &c. Answer.

Example 2. What part of a furlong are 101 yards 2 feet $9\frac{1}{2}$ inches? A furlong=220 yards.

Yds. ft. in.	
101..2..$9\frac{1}{2}$	220 yards
3	3 feet
305 feet	660
12	12 inches
3669 inches	7920 inches
2	2
7339 half inches	15840 half inches

Fraction $\frac{7339}{15840}$)7339000000

Decimal ... .46332007, &c. Answer.

OF

DUODECIMALS, OR CROSS MULTIPLICATION.

Duodecimal Arithmetic is the art of multiplying feet, inches, &c. into each other, by a process, different from that of common or decimal arithmetic.

In duodecimals the calculation decreases by twelves, from the place of feet, towards the right hand. Inches in this rule are commonly denominated *primes;* and are marked thus ′; the next division after inches are called *parts* or *seconds,* and marked thus″; the next are *thirds,* marked thus‴, &c.

Rule. Under the multiplicand write the corresponding denominations of the multiplier, *i. e.* feet under feet, inches under inches, &c.

2. Multiply each term in the multiplicand, beginning at the lowest, by the feet in the multiplier, and set each result under its respective term; observing, to carry an unit for every 12, from each lower denomination to its next superior.

3. Multiply every term in the multiplicand by the inches in the multiplier, and set the result of each term one place removed to the right of those in the multiplicand.

4. Proceed in the same manner with the seconds, and all the other denominations, setting the product of each line one place farther to the

right than the preceding one. The sum of all these lines will be the product required.

Feet	by	feet	give	feet.
Feet	by	primes		primes.
Feet	by	seconds		seconds.
Primes	by	primes		seconds.
Primes	by	seconds		thirds.
Primes	by	thirds		fourths, &c.
Seconds	by	seconds		fourths.
Seconds	by	thirds		fifths.
Seconds	by	fourths		sixths, &c.
Thirds	by	thirds		sixths.
Thirds	by	fourths		sevenths.
Thirds	by	fifths		eighths, &c.

EXAMPLE 1. Multiply 7 feet, 6 inches, by 5 feet, 4 inches.

	ft.	*in.*	
	7	6	
	5	4	
	35		
	2	6	
	2	4	
		2	0
Product	40	0′	0″ square feet.

Here, in the first instance, 5 feet multiplied by 7 feet, give 35 feet; then 6 inches by 5 feet produce 30 inches, or 2 feet 6 inches. Next 7 feet multiplied by 4 inches, give 28 inches, or 2 feet 4 inches; and 6 inches by 4 inches, give 24 seconds, or 2 inches. The sum of all the products is 40 square feet as shewn in the operation,

EXAMPLE 2. Multiply 54 feet 6 inches and a quarter, by 22 feet nine inches and a half.

54 feet 6¼ inches, is...............	54°	6′	3″		
22 feet 9½ inches, is...............	22	9	6		
	108	0	0		
	108	0	0		
	11	0	0		
	—	5	6		
	40	6	0		
	—	4	6		
	—	0	2	3‴	
	2	3	0		
	—	—	3	1	6⁗
Product.	1242	7	5	4	6 Answer.

INVOLUTION.

Involution is the multiplication of any number by itself a given number of times; the product is called a power.

Every number is the first power of itself; consequently, when multiplied by itself, it is called the 2d power or square; when multiplied once more by itself, the 3d power or cube; if again, the 4th power, &c.; so that the number or *index*, called also *exponent*, of the power exceeds the number of multiplications by 1.

It is therefore evident that, to ascertain the value of any power, nothing more is requisite, than to multiply the original number, or *root*, into itself, a number of times less by one, than the index of the power required.

Example. Find the square of 23.

$$\begin{array}{r l}
23 & \\
23 & \\
\hline
69 & \\
46 & \\
\hline
529 & \text{the Answer.} \\
\hline\hline
\end{array}$$

Required the cube of 42.

$$\begin{array}{r l}
42 & \\
42 & \\
\hline
84 & \\
168 & \\
\hline
1764 & \\
42 & \\
\hline
3528 & \\
7056 & \\
\hline
74088 & \text{the Answer.} \\
\hline\hline
\end{array}$$

If the number of figures should be odd, dot the first figure, and afterwards every second figure towards the right. The operation may be considerably shortened by the use of the following observations.

The product of two powers multiplied into each other, is that power whose index is the sum of the indexes of the two factors; thus the cube $\times$ the square $=$ the 5th power—for $3\times 2=5$. The index of the cube being 3, and of the square, 2.

Also, when a power is multiplied by itself, the product is a power whose index is double that of the multiplier. Thus the square $\times$ the square $=$ 4th power. The cube $\times$ the cube $=$ 6th power, &c.

INVOLUTION BY DECIMALS

Is very nearly the same as in whole numbers.

RULE. Multiply as usual, and cut off as many figures from the quotient for decimals, as there are decimal figures in the dividend and divisor.

EXAMPLE. Find the square of 4.5

```
  4.5
 ----
  225
 180
 ----
20.25 Answer.
```

Find the cube of 5.5

```
    5.5
   ----
    275
   275
   ----
  30.25
    5.5
  -----
  15125
 15125
 ------
166.375 Answer.
```

The method of shortening the operation by the addition, &c. of the indices has been fully explained in the article Involution.

EVOLUTION.

EVOLUTION is the extraction of roots; a root of any power is the number that, being multiplied into itself a number of times, less by one, than the index of the power, will produce the power. The root takes its denomination from the number of multiplications+1; so that is called the 2d, 3d, or 4th root, as it is multiplied 1, 2, or 3 times, in order to produce the power. Roots, besides the mark $\surd$, are sometimes designated by a fraction; as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, for the 2d, 3d, or 4th root.

TO EXTRACT THE SQUARE ROOT.

BEGIN from the left hand; and on every second figure towards the right, place a dot. See p. 19. Find the next less root to the first period, and place it to the right hand of the given number, as in division. Subtract the square of this root from the first period; and to the remainder, annex the next period, for a dividend.

Double the root already found, and place it to the left hand of the dividend.

Consider, what figure can be annexed to this divisor; by which, if the sum represented by the union of the two figures, be multiplied, it shall be equal to, or next less than, the dividend.

Having found this figure, and its product, subtract the latter from the dividend; to the remainder annex the next period for a new dividend; then, double the figures already found, for a divisor, and proceed as before, till the operation be complete.

EXAMPLE. Find the square root of

```
        1̇7.3̇05̇6̇  (4.16 Answer.
        16
        ------
   81)  1.3̇0
  81×1= .81
        ------
  826)  .4956
826×6=4956
        ======
```

What is the square root of 256?—Answer 16.

D°.................... 3.........1.732050.
D°.................... 5.........2.236068.
D°.................... 10.........3.162278.
D°....................3025 .... 55.
D°....................4896........ 6.99714.
D°....................2495........ 4.99499.

In order to extract the roots of vulgar fractions, reduce them to decimals, or find the root of the denominator; and place the root of the numerator above it. When the fraction is less than an integer, the root exceeds the power. Thus the root of $\frac{25}{36}=\frac{5}{6}$. $\frac{5}{6}=\frac{30}{36}$. Consequently, the root exceeds the power.

EXTRACTION OF THE CUBE ROOT.

RULE 1. Divide the given number into periods of 3 figures each; find the next less cube of the first period; set the root in the quotient; deduct the said cube from the 1st period; and, to the remainder, annex the following period for a *resolvend.*

2. Find the triple square of the root already found; and place three times the root under it; but one figure more to the right. Add them together. The sum is a divisor.

3. Cut off the last figure of the resolvend; and divide the remaining figures by the divisor; annex this to the figure in the quotient already found.

4. Cut off from the quotient the figure last found; multiply the square of the figures preceding it by 3; then, multiply three times the said figures by the square of the figure cut off: and lastly, find the cube of the figure cut off; add them all together in the above order, placing the 2d product one figure more to the right hand than the 1st, and the 3d one more than the second.

5. The sum is called the *subtrahend;* which must be as nearly equal to the *resolvend* as possible, but not exceed it: if it does, repeat the operation for finding it, till it is either less than, or exactly equal to, the subtrahend.

6. Deduct the subtrahend from the resolvend; to the difference annex the next period of the given number; then proceed as before to find a divisor, &c.

Required the cube root of

$1^2 \times 3 = 3$)2350976359(1[3[2[9[6 Quotient

$1 \times 3 \quad 3$ 1

Divisor 33 135[0 Resolvend.

$1^2 \times 3 \times 3 = 9$

$1 \times 3 \times 3^2 = 27$

$3^3 \ldots\ldots\ldots \; 27$

Subtrahend 1197

Resolvend 1350

Subtrahend 1197

153.97[6 new Resolvend.

$13^2 \times 3 = 507$ $13^2 \times 3 \times 2 = 1014$

$13 \times 3 = 39$ $13 \times 3 \times 2^2 = 156$

$2^3 = 8$

Divisor 5109 102968

Resolvend 153976

Subtrahend 102968

New Resolvend 51008.35[9

$132^2 \times 3 = 52272$ 3 times $132^2 \times 9 = 470448$

$132 \times 3 = 396$ 3 times $132 \times 9^2 = 32076$

$9^3 = 729$

Divisor 523116

Subtrahend 47366289

Resolvend 51008359

Subtrahend 47366289

.3642070000[0 new Resolvend.

3 times $1329^2 = 5298723$ 3 times $1329^2 \times 6 = 31792338$

3 times $1329 = 3987$ 3 times $1329 \times 6^2 = 143532$

$6^3 = 216$

Divisor 52991217

Subtrahend 3180669336

Resolvend 3642070000

Subtrahend 3180669336

Difference 461400664

And so proceed. Answer 13296 nearly.

Examples. What is the cube of 1000? Answer 10.
D°..............3375......15 Answer.
D°..............17 ......2.571282.
D°..............25 ......2.924018.
D°..............42 ......3.476027.

A SIMPLER METHOD OF EXTRACTING THE CUBE ROOT.

Rule 1. By trial, find the nearest cube to the given number, and call it the assumed cube.

2. Then, as the sum of the given number, and double the assumed cube, is to the sum of the assumed cube, and double the given number, so is the root of the assumed cube to the root required, nearly.

3. Assume the cube of the root last found as a new *assumed cube*, and proceed as before, by which a root will be found approximating still more nearly to the real root. This is a sufficiently exact method for all general purposes. The oftener the operation is repeated, the more exact will be the result.

Example. Required the cube root of 128000.

It lies between 50 and 51.

Assumed cube 125000. Root 50.

As 128000+twice 125000 or : 125000+twice 128000 or 378000 : 381000 : : 50—so 50 to 50 4 nearly. Cube of 50.4=128024, and 064=exceeding 128000 by 24.064 only.

LOGARITHMS.

Logarithms are a series of numbers, or rather roots of numbers, calculated in order to facilitate those operations, which cannot be performed, without extreme labour and delay, by common arithmetic.

By means of a table of logarithms, multiplication is performed by addition, and division by subtraction.

The integer prefixed to a logarithm is called its index; thus 2 is the index, the logarithm 2.2081725.

The logarithm of 10 is 1; of 100, is 2; of 1000, 3; of 10000, 4, &c. When the number for which a logarithm is wanted lies between 1 and 10; 10 and 100; 100 and 1000, &c. a reference must be made to a table of logarithms.

The index of the logarithm of any integer or mixed number is always 1 less than the number of integer places in the natural number. Thus, between 100 and 1000, it is 2; 1000 and 10000, 3, &c.

The index is generally omitted in tables for the sake of brevity.

To find the Logarithm of any mixed Decimal Number.

Rule. Find the logarithm as if it were a whole number, and prefix the index of the integer part.

What is the logarithm of 259.7, is 41447, to which, if the index be prefixed, the logarithm is 2.41447.

TO FIND THE LOGARITHM OF A VULGAR FRACTION.

SUBTRACT the logarithm of the denominator from the logarithm of the numerator, borrowing 10 in the index, when the denominator is the greatest, the remainder is the logarithm required.

What is the logarithm of $\frac{5}{9}$?

Logarithm of 5=69897
9=95424

9.74473 Answer.

MULTIPLICATION BY LOGARITHMS.

ADD the logarithms together of the multiplier and multiplicand, the sum is the logarithm of the answer required.

Multiply 9 by 253.

Logarithm of 9=.95424
253 40312

1.35736

35736 is the logarithm of 2277, the Answer.

DIVISION BY LOGARITHMS.

SUBTRACT the logarithm of the divisor from the logarithm of the dividend; the difference is the logarithm of the quotient.

Divide 477 by 3.

Logarithm of 477 .67852
3 47712

20140

2014=logarithm of 159, the Answer.

INVOLUTION BY LOGARITHMS.

MULTIPLY the logarithm of the root by the index of the power to which it is to be raised; the product is the logarithm of the answer.

Required the 5th power of 11.

Logarithm of 11=1.4139
× 5

5.20695

20695 is the logarithm of 161051, the Answer.

EVOLUTION BY LOGARITHMS.

DIVIDE the logarithm of the given number by the index of the power; the quotient is the logarithm of the root.

EXAMPLE. What is the cube root of 156252?

Logarithm of 15625=4.19382. 4.19382÷3=1.397606. 1.397606= logarithm of 25, the Answer.

RULE OF THREE BY LOGARITHMS.

RULE. Add together the logarithms of the 2d and 3d numbers, and from their sum, deduct the logarithm of the 1st. The difference will be the logarithm of the answer.

EXAMPLE. If 110 give 19, what will 94 give?

	110 :	94 : :	19 :
Logarithms	2.04139.	1.97313 : :	1.27875
			1.97313
			3.25188
		Deduct	2.04139
		Difference	1.21049

,21049 logarithm of 16,22, the Answer.

SECTION II.

OF

PRACTICAL GEOMETRY AND MENSURATION.

DEFINITIONS.

THE first definition in Geometry is a *Point*, or dot, which is abstractedly considered as having no parts or magnitude; neither length, breadth, nor depth.

A *Line* is considered as length without breadth.

A *Superficies*, or surface, is an extension, having only length and breadth.

A *Body* or *Solid*, is a figure of three dimensions; namely, length, breadth, and thickness.

Hence surfaces are the extremities of solids; lines the extremities of surfaces; and points the extremities of lines.

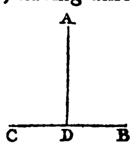
Lines are either right, or curved, or mixed of these two.

A *right* or *straight line* is one which lies evenly between its extreme points, and is the shortest distance between those points.

A *curve* continually changes its direction between its extreme points.

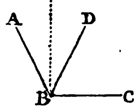
Parallel lines are those which have no inclination towards each other; or which, being every where equi-distant, would never meet, although ever so far produced.

An angle is the inclination or opening between two lines, having different directions, and meeting in a point; hence a *Plane Angle* is a space or corner formed by two straight lines meeting each other.



When a straight line AD standing upon another CB, makes angles ADC, ADB, on each side, equal to one another; each of these angles is called a *Right Angle;* and the line AD is said to be *Perpendicular* to the line CB.

An angle is usually expressed by three letters; that placed at the angular point being always in the middle: as D is the angle of ABC.



An *Obtuse Angle* is that which is greater than a right angle, as ABC.

An *Acute Angle* is that which is less than a right angle, as DBC.

By an ANGLE of ELEVATION is meant the angle contained between a line of direction, and any plane on which the projection is supposed to be made; as the angle formed by the direction of the bowsprit with the plane of the horizon.

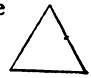
Superficies are either plane or curved.

A *Plane*, or Plane superficies, is that with which a right line may every way coincide; but, if not, it is curved.

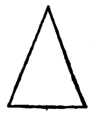
Plane figures are bounded either by right lines or curves. Those that are bounded by right lines have names according to the number of their sides, or of their angles; for they have as many sides as angles; the least number being three.

A figure of three sides and angles is called a *Triangle*. And it receives particular denominations from the relations of its sides and angles. Hence, a *Plane Triangle* is a figure bounded by three right lines.

An *Equilateral Triangle* is that which has three equal sides.

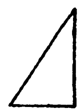


An *Isosceles Triangle* is that which has only two equal sides.



A *Scalene Triangle* is that which has all its sides unequal.

A *Right-angled Triangle* is that which has one right angle.



In a right-angled triangle, the side opposite to the right angle is called the *hypothenuse*, and the other two sides the *legs*, or sometimes, the *base* and *perpendicular*.

An *Oblique-angled Triangle* is that which has no right angle.

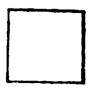
An *Obtuse-angled Triangle* has one obtuse angle.

An *Acute-angled Triangle* has all its three angles acute.

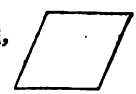
In the same triangle, opposite to the greater side, is the greater angle; and opposite to the greater angle is the greater side.

All plane figures, bounded by four right lines, are called *quadrangles*, or *quadrilaterals*.

A *Square* is a quadrangle, whose sides are all equal, and its angles all right angles.



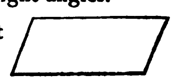
A *Rhombus* is a quadrangle, whose sides are all equal, but its angles not right angles.

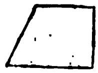


A *Parallelogram* is a quadrangle, whose opposite sides are parallel.

A *Rectangle* is a parallelogram whose angles are all right angles.

A *Rhomboid* is a parallelogram whose angles are not right angles.





All other four-sided figures besides the above are called either *Trapeziums*, or Trapezoids. The latter having only one pair of opposite sides parallel.

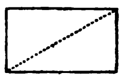
A right line joining any two opposite angles of a four-sided figure, is called the *diagonal.*

All plane figures contained under more than four sides are called *Polygons.*

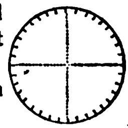
Polygons having five sides are called *Pentagons;* those having six sides *Hexagons;* with seven sides, *Heptagons;* with eight sides, *Octagons;* with nine sides, *Nonagons,* &c.

A *Regular Polygon* is that whose angles and sides are all equal.

The *Base* of any figure is that side on which side it is supposed to stand, and the *Altitude* is the perpendicular falling thereon from the opposite angle. The height or altitude is, therefore, a perpendicular let fall from an angle, or its vertex, to the opposite side, called the base.



If a triangle and parallelogram have equal bases and equal altitudes, the triangle is half the parallelogram.



A *Circle* is a plane figure, bounded by a curve line called the *Circumference,* every part whereof is equally distant from a point within the same figure, called the *Centre.*

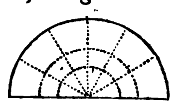
Any part of the circumference of a circle is called an *Arch.*

Any right line drawn from the centre to the circumference of a circle, is called a *Radius.*

All the radii of the same circle are equal.

The circumference of every circle is supposed to be divided into 360 parts, called *degrees;* each degree into 60 equal parts, called *minutes;* and each minute into 60 equal parts, called *seconds.*

A *Quadrant* of a circle will therefore contain 90 degrees, being a fourth part of 360.



Equal angles at the centres of all circles will intercept equal numbers of degrees, minutes, &c. in their circumferences.

The *measure* of every plane angle is an arch of a circle, whose centre is the angular point, and is said to be of so many degrees, minutes, &c. as are contained in its measuring arch.

All right angles, therefore, are of 90 degrees, or contain 90 degrees, because their measure is a quadrant. Acute angles contain less than 90 degrees, and obtuse angles more than 90 degrees.

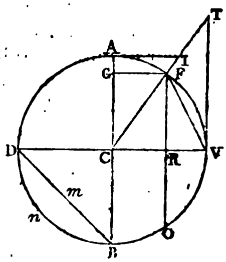
The three angles of every plane triangle, taken together, contain 180 degrees, being equal to two right angles, as demonstrated hereafter.

In a right-angled plane triangle, the sum of its two acute angles is 90 degrees.

The *Complement* of an arch, or of an angle, is its difference from a quadrant or right angle.

The *Supplement* of an arch, or of an angle, is its difference from a semi-circle, or two right angles.

The quantities or magnitudes of arches and angles are determined by certain straight lines, appertaining to a circle, called chords, sines, tangents, &c.



The *Chord* of an arch is a straight line, joining its extreme points, as F R O.

A *Diameter* is a chord passing through the centre, and dividing the circle into two equal and similar parts, as D C V, the half of which, as D C is a *Radius*.

A *Segment* is any part of a circle, bounded by an arch and its chord, as D n, B m.

A *Semi-circle* is half the circle, or a segment cut off by a diameter, and contains, therefore, 180 degrees.

A *Sector* is any part of a circle bounded by an arch, and two radii, drawn to its extremities.

The *Sine* of an arch is a line drawn from one end of the arch, perpendicular to the other side or radius, as F R; and it is half the chord of twice the arch.

The *Versed Sine* of an arch is that part of the diameter intercepted between the sine and the end of the arch, as R V.

The *Tangent* of an arch is a line, V T, proceeding from either end, perpendicular to the radius joining it; its length is limited by a line drawn from the centre through the other end.

Hence one line is tangential, or a tangent, to another, when both are produced, and it touches it without cutting.

The *Secant* of an arch is the line proceeding from the centre, and limiting the tangent of the same arch, as C T.

The *Co-sine* and *Co-tangent*, &c. of any arch is the sine and tangent, &c. of its complement, or what it wants of ninety degrees.

Therefore, in the foregoing figure, F O is the chord of the arch F V O, and F R is the sine arches F V, F A D; R V, R D, are the versed sines of the arches F V, F A D.

V T is the tangent of the arch F V, and of its supplement.

C T is the secant of the arch F V.

A I is the co-tangent, and C I the co-secant of the arch F V.

The chord of 60°, the sine of 90°, the versed sine of 90°, the tangent of 45°, and the secant of 0, are all equal to the radius.

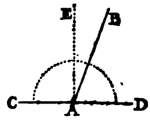
In making use of these lines, it is obvious that we must always make use of the same radius, otherwise there would be no settled proportion between them.

The whole mensuration of figures may be reduced to the measure of triangles, which are always the half of a rectangle of the same base and altitude; and, consequently, their area is obtained by taking the half of the product of the base multiplied by the altitude.

By dividing a polygon into triangles, and taking the value of these, that of the polygon is obtained; and, by considering the circle as a polygon, with an infinite number of sides, we may obtain the measure thereof to a sufficient degree of accuracy for all practical purposes.

The theory of geometry may therefore be reduced to the doctrine of angles, for it treats only of the boundaries of things; and, by angles, the ultimate bounds of all things are formed. The angles give them their figure; and these are measured by the circle as we have shewn.

THEOREMS.

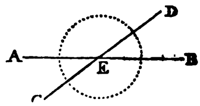


THEOREM I. When a right line as A B, stands upon another right line, as C D, they form two angles, D A B and B A C, which together are equal to two right angles.

DEMONSTRATION, &c.

If A B were perpendicular to C D, each of the angles would be a right angle. But, as E A B is the excess of B A C above a right angle, and D A B is less than a right angle by the same quantity, the angles D A B and B A C must be equal to two right angles.

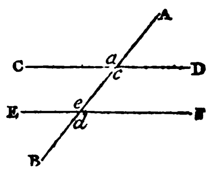
HENCE, if ever so many right lines stand thus on one point A, on the same side of a right line C D, the sum of all the angles are equal to two right angles, or 180 degrees; and, all the angles formed about the same point, by any number of lines, are altogether equal to four right angles.



THEOREM II. If two right lines intersect each other, the opposite angles are equal.

DEMONSTRATION, &c.

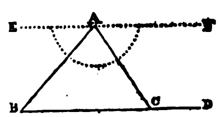
By theorem the first, the angles BED, D E A, are equal to two right angles; for the same reason, the angles A E C, C E B, are also equal to two right angles: and, by subtracting a common angle on each side, the remaining angles will be equal. Consequently, the angle D E B is equal to the angle A E C, and the angle A E D to B E C.



THEOREM III. If a straight line A B, intersect two parallel straight lines, C D, E F, the alternate or opposite angles will be equal, and the outward angle *a* will be equal to the inward and opposite angle *e*.

DEMONSTRATION.

If we suppose the space between C D and E F to be a line, the outer opposite angles are equal by the last theorem. By the same reason the angle *a* is equal to the angle *e*, and the angle *c* to the angle *d*. Consequently the alternate angles are equal, &c.



THEOREM IV. In any right-lined triangle the sum of the three angles is equal to 180 degrees, or two right angles; and, if one side of the triangle, as BC, be continued or produced, the outward angle AC D will be equal to the sum of the two inward and opposite angles A and B.

DEMONSTRATION.

Through the point A draw a right line E F, parallel to B D; then, by Theorem III. the angle E A B is equal to the angle A B C, and F A C to A C B: hence the three angles included in the semi-circle are equal to the three angles of the triangle. Again, the three angles in the semi-circle are equal to two right angles, or 180 degrees, and the three angles of the triangle are also equal to two right angles.

The two angles D C A, A C B, are, likewise, equal to two right angles, as before shewn; and are, of course, equal to the three angles of the triangle. Subtracting, therefore, the common angle A C B, the angle A C D must be equal to the opposite angles C A B, A B C.

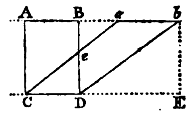
Hence; 1. The sum of any two angles of a triangle subtracted from 180 degrees, gives the third angle.

2. If the sum of any two angles of a triangle be equal to the sum of any two angles of another, the remaining angle of the first triangle must be equal to the remaining angle of the other triangle.

3. The sum of the two acute angles of a right-angled triangle, is equal to a right angle; and, therefore, if one be given, the other is found by subtracting it from 90 degrees.

4. The four angles of every quadrilateral figure are altogether equal to four right angles.

Theorem V. Parallelograms standing on the same base, or equal bases, and between the same parallels, are equal.

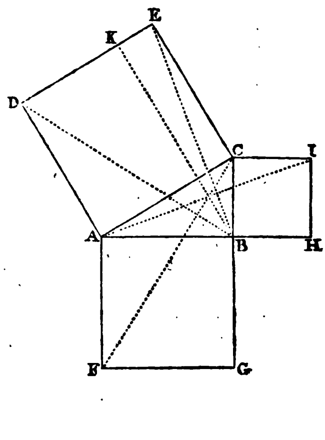


DEMONSTRATION, &c.

As AB is equal to C D, so must A *a* be equal to B *b*; B *a* being common to both. And, because A C equals B D, as the angle A equals the angle C, the triangle A C *a* is equal to the triangle B D *b*; and if, from both these triangles, the common triangle B*ea* be taken, there will remain the trapezium AB*e*C equal to the trapezium *ab*D*e*. Now the trapezium AB*e*C, added to the triangle C*e*D, is equal to the parallelogram A B *c* D: and the trapezium *a b* D *e*, added to the triangle C *e* D is equal to the parallelogram *a b* C D. Consequently the parallelogram A B C D is equal to the parallelogram *a b* C D.

Hence, All triangles standing upon the same base, or upon equal bases, and between the same parallels, are equal: for all triangles are the halves of their circumscribing parallelograms; and, if the whole be equal, their halves must also be equal.

Theorem VI. In any right-angled triangle, the square of the hypothenuse, or side opposite to the right angle, is equal to both the squares of the sides containing it.



DEMONSTRATION, &c.

Let the triangle A B C have a right angle at B; then will the square of A C be equal to the sum of the squares of A B, B C.

For, upon A B, B C, C A, describe the squares A E, B F, B I; draw likewise B K parallel to E C, and join B D, B E, A I, and C F.

Now the angle D A C is equal to the

angle F A B, each being a right angle, and, by adding the angle B A C, common to both, the angle B A D is equal to the angle F A C. Also, because A B is equal to A F, and A D equal to A C, by construction; the triangle B A D is equal to the triangle F A C.

The parallelogram A K is equal to twice the triangle B A D and the square A G is equal to twice the triangle A F C, consequently the parallelogram A K is equal to the square A G.

In like manner it may be shewn that the parallelogram C K is equal to the square C H. Therefore the square A E is equal to the sum of the parallelogram A K, C K, and the sum of the squares A G, C H.

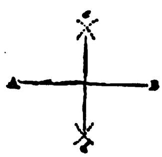
Hence, from two sides of a right-angled triangle given, the third may be easily found: for, if the two sides containing the right-angle are given, the hypothenuse may be found by adding the squares of the two given sides together, and extracting the square root of the sum. Or, if the hypothenuse and one of the legs be given, the square of the given leg, subtracted from the square root of the hypothenuse, will leave a remainder, the square root of which will be the side required.

GEOMETRICAL PROBLEMS.

The case of drawing instruments, fitted for the purposes of a ship-builder, usually consists of a pair of compasses, with a shifting leg, to admit a steel pen or a pencil holder; a pair of compasses with spring joint, for taking or marking distances with the greatest accuracy; a pair of bows for sweeping small circles; a steel drawing pen; a drawing pen and pencil holder for the compasses; a pen-knife and pencil; a parallel rule for drawing lines parallel to each other; and, a plane scale, generally of ivory, having upon it the following graduated lines; viz. upon one side, a protractor and a line of chords for measuring and laying off angles, with a decimal diagonal scale of equal parts, divided into half and quarter inches, and subdivided into hundredth parts of an inch, as shewn hereafter. The other side of the scale is occupied with lines, graduated into equal parts, as one inch, $\frac{7}{8}$, $\frac{3}{4}$, $\frac{5}{8}$, $\frac{1}{2}$, $\frac{3}{8}$, $\frac{1}{4}$, and $\frac{1}{8}$ of an inch. The latter are generally used in the construction of plans, as so many parts of one inch to a foot, and one division at the end of each, is subdivided into twelve parts, for inches, accordingly.

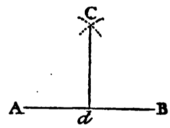
With these instruments the following and other problems may be correctly performed.

1. *To divide a given right line into two equal parts.*



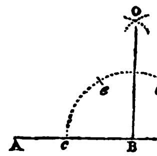
From the points A and B, with any distance greater than the half of A B describe with compasses, arcs cutting each other in e and d. Draw the line eCd, and it will divide the given line into two equal parts.

2. *From a given Point, in or near the middle of a given Line to draw a Perpendicular to the given Line.*



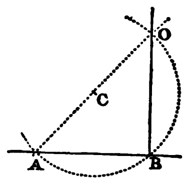
On each side of the point *d* take any two equal distances *d* A, *d* B; and, from the points A B, with any radius greater than *d* A, *d* B, describe two arcs intersecting in C. The line *d* C, drawn through the intersection, will be the perpendicular acquired.

3. *From a given Point, near the End of a given Line, to draw a Perpendicular to the given Line.*



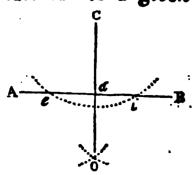
From the point B, with any radius, describe the arch *c e i*; and, from *c* with the same radius, turn the compasses twice over on the arc, as at *e* and *i*. Then, from *e* and *i*, describe the arcs intersecting in O. Now draw B O, and it will be the perpendicular required.

Another Method.



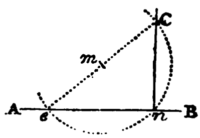
From any point C, as a centre, with the radius C B, describe an arch cutting the given line in A and B. Through A and C draw a straight line to intersect the arch at O. Draw BO, and it will be the perpendicular required.

4. *From a given Point, as* C, *to let fall a Perpendicular to a given Line* A B, *when the Point is nearly over the middle of the Line.*



From the point C, with any radius, describe an arc cutting A B in *e* and *i*. From the points *e* and *i* describe arcs intersecting as at *o*. Then draw C *o*, the perpendicular required.

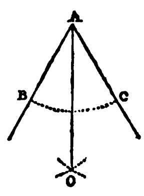
5. *From a given Point, as* A, *nearly over the End of a right Line, to let fall a Perpendicular.*



From C draw a straight line, at pleasure, to meet A B in every point as *e*. Bisect C *e* at *m*; and, from the point *m*, and distance C *m* or A *m*, describe the arch cutting A B in *n*. Now draw C *n* and it will be the perpendicular required.

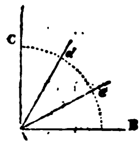
*** In practice, perpendiculars may be more readily raised and let fall, by means of a square, or the protractor on the plane scale before mentioned.

6. *To divide a given Angle into two equal Parts.*



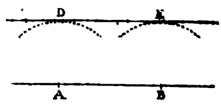
Let B A C be the given angle. From A as a centre describe the arc B C; and, from B and C, with the same radius, describe the arcs intersecting in O. Draw A O and it will divide the angle as required.

7. *To divide a Right Angle into Three equal Parts.*



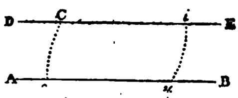
From A, with any radius, describe the arc B C; and, from B with the same radius, cross the arc in *d*, likewise from C in *e*. Through the points *d e* draw A *d*, A *e*, and they will trisect the angle as required.

8. *To draw a Line, as* D E, *parallel to a given right Line,* A B.



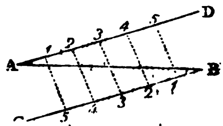
From the given points A and B, with the requisite distance, describe the arches D and E; then lay a ruler to touch the back of the arches, and by it draw the line D E, which will be parallel to the given line as required.

9. *To draw a Line, parallel to a given Line* A B, *which shall pass through an assigned Point, as* C.



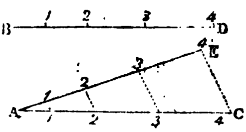
From any point *u*, in the line A B, with the distance C *u*, describe the arc C *o*. From C, with the same radius, describe the arc *i u*. Take the arc C *o* in the compasses, and apply it from *u* to *i*. Through C and *i* draw the line D E which will be the parallel required.

10. *To divide a given Line into a proposed Number of equal Parts.*



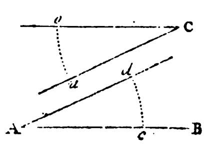
Let it be required to divide the line A B into six equal parts. From the point A draw any line A D, making an angle with the line A B; then, through the point B, draw a line B C, parallel to A D; and, from A, with any small opening in the compasses, set off a number of equal parts on the line A D, less by one than the proposed number (which in this example is 5;) then from B set off the same number of the same parts on the line B C. Join 5 and 1, 4 and 2, &c. and these lines will cut the given line as required.

11. *To divide a given Line in the same Proportion as a given divided Line.*



Let A C be the line to be divided, and B D the graduated line. From A draw a line A E, equal to B D, and upon it transfer the divisions of that line. Join E C, and parallel to it draw the lines 11, 22, 33, &c. which will divide the line A C as required.

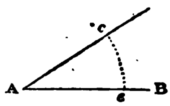
12. *At a given Point as* A, *in a given Line* A B *to make an Angle equal to a given Angle.*



From the point C, with any radius, describe an arc *o u*. From A, with the same radius, describe the arc *d c*. Take the distance *o u* in the compasses, and apply it from *c* to *d*; then will the line A *d*, drawn through *d*, form the angle as required.

13. *At a given Point, on a right Line, to make an Angle of any proposed number of Degrees.*

From the point A, with the radius equal to 60 degrees, taken from the scale of chords, describe the arc *c e*. Then take, in the compasses, from the same scale of chords, the proposed number of degrees, and apply them from *e* to *c*. A line A *c*, drawn through the point *c*, will then form the required angle.



Angles exceeding 90 degrees are set off at twice. But these, or any other angles, may be more readily laid off with the protractor, by laying the centre to the point A, and the base along A B; a dot at the proposed number of degrees will then mark the angle.

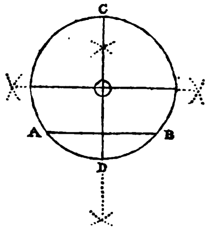
14. *To measure a given Angle, as* A, *above.*

With the chord of 60 degrees describe the arc *c e*; then take the arc in the compasses, and the extent, applied to the scale of chords will shew the number of degrees in the angle.

If the arc exceeds 90 degrees, it may be taken off at twice, as above.

The angle may, however, be more readily measured by applying the protractor, as described in the preceding problem.

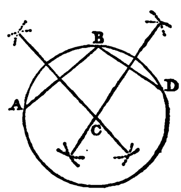
15. *To find the Centre of a Circle.*



Draw a chord, as A B, and bisect it perpendicularly with C D, which will be a diameter. Then bisect C D in the point O and that will be the centre of the circle.

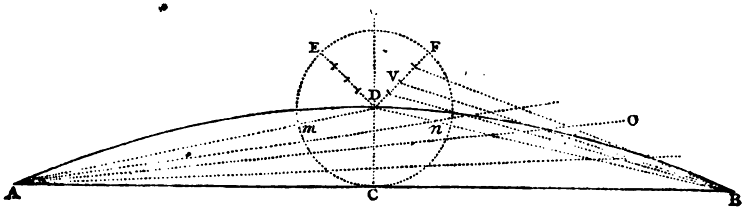
16. *To describe a Circle through any Three given Points not situated in a right Line.*

Let A, B, and D be the given points. From the middle point B draw the lines BA, BD. Bisect these lines perpendicularly by the lines intersecting in the point C. Upon C, as a centre, with the radius C A, then describe the circle required.



*** In the same manner may the centre of an arc be found.

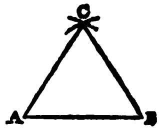
17. *To describe an Arch of large Radius, the base* A B *and height* C D *being given.*



Bisect the base AB in the point C, and draw the line CG. Upon C, set off the given round up, or greatest height, of the required arch, CD. Then draw the lines AD, BD; and, upon D, as a centre, describe a circle. Now, set off *n* F equal to C *n*, and *m* E equal to C *m*, and draw DE, DF. Next divide the radius CD into several parts at pleasure, the more numerous the better; and DF, DE, into a like number of parts, each corresponding with the other. Lines being now drawn, as from A to O, and from B to V, through the corresponding divisions of the radii CD, DF, will intersect each other, and every intersection will be a point in the required arch. This being done on both sides of CD, the arch may be described by applying the edge of a sweep or bow so as to pass through the several points. Thus the round-up of beams, &c. is described.

In practice an arch may be thus described by means of two chalked lines, fastening one at A and the other at B, and stretching the one through the spots in the line DC, and the other through the corresponding spots in DE or DF. The intersections of the chalked lines will give the several points or spots in the circumference, and a batten then pinned to those spots will form the curve ADB, to which the round-up is to be made.

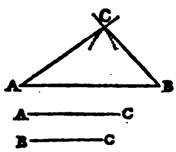
18. *To make an equilateral Triangle on a given Line.*



From the points A and B, with the distance AB, describe arcs intersecting in C. Draw AC, BC, and it is done.

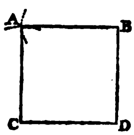
An isosceles triangle may be made in the same manner, taking for the distance the given length of one of the longer sides.

19. *To make a Triangle with Three given Lines.*



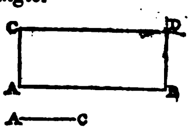
Let the lines be AB, AC, and BC. From the point B and distance BC describe an arc. From the point B, with the distance AC describe another, intersecting the former. The intersection gives the point which will form the triangle required.

20. *To make a Square on a given Line.*



Draw BD equal and perpendicular to CD. From B and C, with the distance CD, describe arcs intersecting in A. Then draw CA and AB which will form the square required.

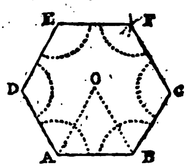
21. *To describe a Parallelogram or Rectangle.*



Let the length of the proposed rectangle be AB, and its breadth AC. Draw AC perpendicular to AB; and, from the point A, with the given breadth, describe an arc. From the points B and C, describe other arcs intersecting in D, which give the point forming the parallelogram.

In the same manner may an oblique parallelogram be described, by drawing AC with the given angle instead of perpendicular.

22. On a given Line, as AB, *to construct any regular Polygon.*



1. Divide 360 degrees by the number of sides; subtract the quotient from 180 degrees; the remainder will be the degrees which measure the angle made by any two adjoining sides of that polygon, which is called the angle of the polygon.

2. At the points A B make angles A B C, B A D, equal to the angle of the polygon. Make B C, A D, each equal to A B; and, at the points C D, make angles equal to that of the polygon as before; and let the sides including those angles be each equal to A B. Thus proceed until the polygon is constructed.

In figures of any number of sides the two last are most readily found by describing arches, as from C and E, intersecting in F.

In those of an even number of sides, having drawn half the number, by means of the angles, the remaining sides may be found by drawing lines parallel, and equal, to their opposite sides.

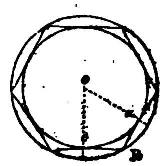
The following table, which shews the angle found at the centre of every polygon, by right lines drawn from the centre of the extremities of one side, together with the angle of the polygon (or angle A B C) and the angles O A B and O B A, will save the trouble of calculation, in the resolution of this problem.

Number of Sides.	Name of the Polygon.	Angle at the Centre.	Angle of the Polygon.	Angle *o* A B or *o* B A
Three	Trigon or Equilateral Triangle	120°	60°	30°
Four	Tetragon or Square	90	90	45
Five	Pentagon	72	108	54
Six	Hexagon	60	120	60
Seven	Heptagon.........................	$51\frac{3}{7}$	$128\frac{4}{7}$	$64\frac{2}{7}$
Eight	Octagon	45	135	$67\frac{1}{2}$
Nine......	Nonagon	40	140	70
Ten	Decagon	36	144	72
Eleven ...	Undecagon	$32\frac{8}{11}$	$147\frac{3}{11}$	$73\frac{7}{11}$
Twelve ...	Dodecagon	30	150	75

23. In a given Circle to inscribe any regular Polygon, or to divide the Circumference into any Number of equal Parts.

At the centre O make an angle equal to one half of the angle of the polygon. Then the distance A B will be one side of the polygon; which, being carried round the circumference the proper number of times will complete the figure.

24. To find the Centre of a Polygon, or the Centre of its inscribed or circumscribing Circle.

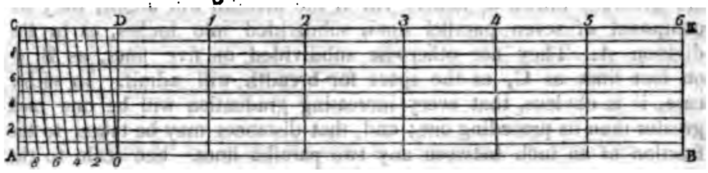


Bisect any two sides with the perpendiculars *o a c*, and their intersection will be the centre. From the centre *o*, with the radius *o c*, the inscribed circle may now be drawn; or, with the radius to one of the angles, as B, the circumscribing circle may be drawn.

By this method a circle may be circumscribed about any given oblique triangle.

26. *To construct Plane Scales for draughting, &c.*

1. The decimal diagonal scale.



Draw the line A B, and divide it into any number of equal parts for the primary divisions. Next erect the perpendiculars A C, &c. equal in height to the given breadth of the scale. Divide each of the perpendiculars A C and B E into ten equal parts, and through the divisions draw parallel lines of the whole length of the scale. Then divide the length of the first division C D into ten equal parts, both on C E and A B, and connecting the points by diagonal lines, the scale will be finished, and may be numbered at pleasure.

Scales of this description are made use of for taking off dimensions or numbers of two or more figures. For instance, if the largest divisions be taken as units, the smaller divisions between A and *o* will be tenth parts, and the divisions in the height will be hundredth parts. If the larger divisions be taken as tens, the next smaller will be hundredths, and the smallest thousands, &c. Each set of divisions being tenth parts of the former ones.

Examples. To take the distance representing one and three tenths (1.3) from the scale, set one foot of the compasses, on the base line, to the larger division 1, and open the other leg to 3 in the smaller divisions between A and 0. The extent will be the distance required.

To take a distance equal to 25, set, in like manner, one foot of the compasses on the larger division 2, and extend the other to the smaller division 5 on the base, which will be the distance.

For 346, the larger divisions being in this case taken as hundredths, set one leg in three, upon the line marked 6 at the end, and extend the other to the diagonal 4, which will be the extent required.

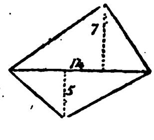
And, conversely, may the length of any line, be measured relatively to another of a determinate length.

2. *A diagonal Scale, for Feet, Inches, and Eighths of an Inch.*

This is constructed upon the same principle as the former. The larger divisions representing feet, the subdivisions, A to 0 inches, and the graduations in the height, eighths of an inch. Hence, to take off an extent equal to four feet six inches and three-eighths of an inch, place the com-

PROBLEM 5. *To find the Area of a Trapezium.*

RULE. Divide the trapezium into two triangles by a diagonal; then find the areas of these triangles, by Problem 3, and add them together; the sum will be the area of the trapezium.



Or, if two perpendiculars be let fall on the diagonal, from the two opposite angles, the sum of these perpendiculars being multiplied by half the diagonal gives the area of the trapezium.

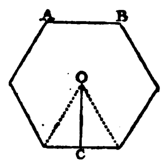
EXAMPLE. Half the diagonal $14=7$, multiplied by 12, the sum of the two perpendiculars $7+5$, produces 84 square feet, the area of the trapezium.

PROBLEM 6. *To find the Area of an irregular Polygon.*

RULE. Draw diagonals dividing the figure into trapeziums and triangles. Then find the areas of all these separately, and their sum will be the content of the whole figure.

PROBLEM 7. *To find the Area of a regular Polygon.*

RULE 1. Multiply half the sum of the sides by the perpendicular falling from the centre on one of its sides, and the product will be the area required.



EXAMPLE. Suppose in a regular hexagon each side, as A B, is 12 inches, and the perpendicular O C $10\frac{3}{8}$ inches. Required the area?

Here $6\times 12=72$, the sum of the sides, half of which is 36; therefore, 36 multiplied by $10\frac{3}{8}$ inches, the perpendicular, produces $373\frac{1}{2}$ inches, the area.

Or, by RULE 2. Square the side of the polygon; multiply that square by the multiplier set against its name in the annexed table, and the product will be the area.

No. of Sides.	Names of the Polygons.	Multipliers.
Three......	Trigon or equilateral triangle..	0.4330127
Four........	Tetragon or square.............	1.0000000
Five.........	Pentagon	1.7204774
Six..........	Hexagon..........................	2.5980762
Seven.......	Heptagon.........................	3.6339124
Eight........	Octagon...........................	4.8284271
Nine.........	Nonagon..........................	6.1818242
Ten	Decagon	7.6942088
Eleven......	Undecagon........................	9.3656399
Twelve......	Dodecagon........................	11.1961524

By means of this table the above question will stand thus, $12 \times 12 = 144$ inches, the square of one of the sides of the hexagon; and this, multiplied by the tabular number 2.5980762, will produce 374 inches, agreeing within half an inch of the former result.

PROBLEM 8. *To find the Area of a Circle.*

PRELIMINARY OBSERVATIONS. A circle is the most capacious of all plane figures, as it contains the greatest area within the same perimeter; or, has the least perimeter about the same area. Its area is always less than the area of any regular polygon circumscribed about it, and its circumference always less than the perimeter of the polygon. Nevertheless, its area is always greater than that of its inscribed polygon, and its circumference greater than the perimeter of the latter.

The area of a circle is equal to that of a triangle, whose base is equal to the circumference, and perpendicular equal to the radius.

Circles, like other similar plane figures, are to one another as the square of their diameters; and the area of the circle is to the square of its diameter, as 11 to 14 nearly; or, more nearly, as 0.7854 to 1.

In the opinion of the most celebrated mathematicians, the radius and circumference of a circle are lines incommensurable to each other; or, in other words, their exact relative proportion is indefinable: at least, it has so appeared from actual calculations which have been carried to 128 places of figures. For practical purposes, it will generally suffice, that the diameter, is to the circumference nearly as 1 to 3.1416; or, as 7 : 22 nearly; or still more nearly as 106 to 333; as 113 to 355; as 1702 to 5347; and, as 1815 to 5702, &c. each of which, exclusive of the first, is more accurate than the foregoing.

From the difficulty of determining the proportion between a right line and a curve, the mathematicians have considered the circle as a polygon of an infinite number of equal sides. If, therefore, the half-sum of these be multiplied by half the diameter, or radius, or the whole sum by one fourth of the diameter, the product will be the area of the circle, as in the preceding problem. But, before this can be done, the circumference, or sum of the sides of which the circle is supposed to be composed, must be found by the afore-mentioned proportions. The rule for finding the area is, therefore, as follows.

RULE. Multiply the circumference by one fourth of the diameter, or half the radius, and the product is the area required.

EXAMPLE. What is the area of a circle whose diameter is 16 feet?

As 1 to 3.1416 : : 16 : 50.2656, the circumference. Then,

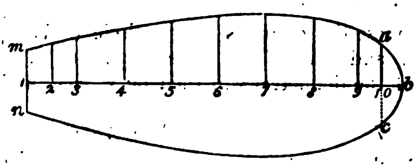
Multiply 50.2656, the circumference,
By........... 4, half the radius.

201.0624, the area required.

The result will be the same by multiplying half the circumference by half the diameter; or, by multiplying the whole circumference by the whole diameter, and taking one fourth of the product.

If the breadths be not taken at equal distances, or if the figure be very irregular, compute all the trapezoids separately, and add them together. But, if the figure be not very irregular, a mean of the distances between the different perpendiculars may be taken, as for the breadths.

EXAMPLE 2. Suppose it were required to find the area of the horizontal section of a ship as in the annexed figure; the perpendiculars to the middle line 1 B, and distances between the perpendiculars being as under.



	Ft.	In.			Ft.	In.	
Perpend. 1...	7.	0.	Distance between each 5. 10.=11 ft.	Perpen. 6...	14.	0.	Dist. 10 ft.
2..	8.	0.		7...	15.	0.	
3...	9.	0.		8...	14.	0.	
4...	11.	10.	Distance between each, 10 feet	9...	11.	0.	Dist. 4 ft.
5...	13.	0.		10...	8.	0.	

OPERATION.

FIRST add half the sum of the first and third half-breadths to the length of the second, and take the half for a mean breadth as follows:

	Ft. In.		
Length of the first perpendicular	7. 0.		
third...............	9. 0.		
	2)16. 0.	Sum.	
	8. 0.	Half sum.	
Length of the 2d perpendicular	8. 0.		
	2)16. 0.		
	8. 0.	Half sum.	
Multiply by...	11. 0.	Distance between.	Areas. Ft. In.
	88. 0.	Area between 1 and 3...	88. 0.

Now find the area between 3 and 4, by taking the mean breadth, and multiplying by the distance between, viz.

Length of the 3d perpendicular 9. 0.
4th............... 11. 10.

2)20. 10. Sum.

10. 5. Half sum.
10. 0. Distance between.

Product 104. 2. Area between 3 and 4...104. 2.

In the same manner we shall find the area between 4 and 5...124. 2.
between 5 and 6...135. 0.
between 6 and 9...405. 0.
between 9 and 10.. 38. 0.

Sum of the whole section between 1 and 10,
on one side of the middle line ....894. 4.
2.

This doubled for the complete section, gives......................1788. 8.
To which add the circular segment *a b c* at the bow, as found
by Problem 11 .... 53. 6.

Total...1842. 2.

Example. There is another and more expeditious method of solving this problem, by spacing the perpendiculars at equal distances, and taking the lengths of all the perpendicular lines; then adding the whole together, excepting the foremost and aftermost, of which only the one half is to be taken, and multiplying by the mean distance between each, as in the following example.

Let us suppose the perpendiculars equally spaced, and to measure as follow:

	ft.	in.		ft.	in.
Perpendiculars 1...	7.	0.	the half of which is	3.	10.
2				8.	10.
3				10.	0.
4				12.	0.
5				13.	0.
6				13.	9.
7				14.	10.
8				15.	0.
9				14.	0.
10				10.	2.
11...	8.	0.	the half of which is...	4.	0.
				119.	5.
Multiply by mean distance between each...				7.	6.

Area of one side of the middle line	895.	$7\frac{1}{2}$.
		2.
Whole area from 1 to 11	1791.	3.
Area of the segment at the bow	53.	6.
Total...	1844.	9. Nearly as before.

The difference arises from small fractions not worthy of notice.

It remains to be observed, that, with respect to similar examples, where the breadths increase or decrease very fast, with respect to each other, the nearer that every two adjacent transverse lines, or perpendiculars, are placed, the more exact will be the computation.

MENSURATION OF SOLIDS.

DEFINITIONS.

A BODY or SOLID is, as we have already defined it, a figure having three dimensions, namely, length, breadth, and thickness. And, as a superficies is bounded by lines, so is a solid bounded by superficies.

A *Regular Body* is a solid contained under a certain number of similar, equal, and regular plane figures.

A *Prism* is a solid, whose ends are equal, parallel, and similar. If the ends be triangles, it is called a triangular prism; if square, a square prism; if pentagons, a pentagonal prism, &c.

A *Cube* is a square prism, having six equal sides, perpendicular to each other.

A *Parallelopiped*, or parallelopipedon, is a body having six rectangular sides, every opposite pair of which are similar, parallel, and equal.

A *Cylinder* is a round prism, having circles for its ends; and being therefore in form of a rolling stone.

A *Pyramid* is a solid having any plane figure for its base, as a square, triangle, or polygon, &c. Its sides are triangles which meet in a point at the top called the vertex.

The pyramid, like the prism, is called triangular, square, &c. according to its number of sides.

A *Cone* is a round pyramid, whose base is a circle, whence it gradually tapers to the vertex.

A *Sphere*, or globe, is a solid bounded by one uniform convex surface, every point of which is equally distant from a point within, called the centre. The sphere may be conceived to be formed by the rotation of a semi-circle about its diameter.

The *Axis* of a solid is a line, or imaginary line, drawn from the middle of one and to the middle of the opposite end, and about which it may turn. Hence the axis of a cone is a straight line or imaginary line from the vertex to the middle of the base.

If the axis be perpendicular to the base, the cone is said to be a *right cone.* If otherwise, it is called a *scalenous* or oblique cone. The same of a pyramid or other figure.

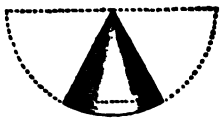
The *Altitude* or height of a solid is a line drawn from its vertex or top, perpendicular to its base. In a right prism or pyramid this is therefore equal to the axis; but, in an oblique one, the altitude is the perpendicular side of a right-angled triangle, of which the hypothenuse is the axis.

The *Segment* of a solid is a part cut off the top, by a plane parallel to the base.

A *Frustum* or trunk is a part that remains after the segment is cut off.

The *Zone* of a sphere is a part intercepted between two parallel planes; and is the difference between two segments. If the ends, or planes, be equally distant from the centre, on both sides, the zone is called a middle zone.

The *Sector* of a sphere is a figure formed by a segment less than a hemi-sphere or half a sphere, united with a cone having the same base with the segment and its vertex in the centre of the sphere.



A *Circular Spindle*, is a solid which is supposed to be generated by the revolution of the segment of a circle about its chord, as A B.

A  B

A *Spheroid*, being formed by a conic section, is explained hereafter under the head of "Conic Sections."

PROBLEM 1. *To find the solid Content of a Cube.*

RULE. Multiply the length, breadth, and depth (which are all equal) into one another; and the last product will be the content required.

EXAMPLE. What is the solid content of a cube, whose length, breadth, and depth, are each equal to 17 inches?

$17 \times 17 = 289$; and $289 \times 17 = 4913$ inches; this divided by 1728, the number of cubic inches in a foot, gives 2 feet 1457 inches; or, by duodecimals, 2 feet 10 inches solid.

PROBLEM 2. *To find the solid Content of a Parallelopiped.*

RULE. Multiply the length by the breadth, and that product by the depth or height.

EXAMPLE. Required the solid content of the parallelopipedon, whose length is 4 feet 8 inches, breadth 3 feet 6 inches, and depth 2 feet 5 inches.

4 Feet 8 inches multiplied by 3 feet 6 inches produces 16 feet 4 inches; and this product, multiplied by 2 feet 5 inches, produces 39 feet 5 inches and $\frac{2}{3}$, the solid content required.

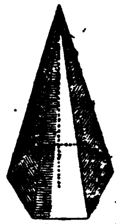
PROBLEM 3. *To find the solid Content of a Prism.*

RULE. Find the area of its base, and multiply it by the height or length. The product will be the area required, whether the prism be triangular or square, or of any otherfigure, as a pentagon, cylinder, &c.

EXAMPLE. Suppose the section to be a regular hexagon (as in Problem 7, page,) whose area is 2 feet 7 inches, and the length 7 feet.

Here 2 feet 7 inches, multiplied by 7 feet, produces 18 feet and one inch, which is the solid content.

PROBLEM 4. *To find the solid Content of a Pyramid, or of a Cone.*



RULE. Find the area of the base, multiply that area by the height, and divide the product by three. The quotient will be the solid content required. Or, which is the same in effect, find the area of the base and multiply it by one third of the height.

EXAMPLE 1. Required the solid content of a pyramid, whose base is a regular hexagon, and area 2 feet 7 inches, as in Problem 3, and height 7 feet.

In this case, as before, 2 feet 7 inches multiplied by 7 feet produces 18 feet one inch, one third of which, or 6 feet and $\frac{1}{3}$ of an inch, is the solid content of the pyramid.

EXAMPLE 2. Required the solid content of a cone, the diameter of whose base is 20 inches, and its height 63 inches.

By Problem 8, page 39, find the area of the base thus:

As 1 : 3.1416 : : 20 : : 62.832, the circumference.
Then multiply...... 62.832, the circumference,
By 5. , or one fourth of the diameter.

Product 314.16 the area of the base,
Which, multiplied by 21 inches; one-third of the height,

Produces 6597.36 inches; or 3.82 feet nearly, the solid content.

PROBLEM 5. *To find the solid Content of a Sphere or Globe.*

RULE. Find the cube of its diameter or axis, and multiply it by .5236.

EXAMPLE. Required the solidity of a globe, whose diameter or axis is 18 inches.

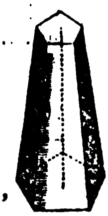
18 × 18 × 18 is equal to 5832 the cube.
Therefore......................5832
Multiplied by the decimal...5236

Produces 3053.6 cubic inches, the solid content.

PROBLEM 6. *To find the solid Content of the Frustum of a Cone or Pyramid.*

RULE. Add into one sum the areas of the two ends, and the mean proportional between them, or the square root of their product; and take one-third of that sum for a mean area; which, multiplied by the height of the frustum, will give the solid content.

If the ends be regular plane figures, the mean area will be found by multiplying one third of the corresponding tabular number belonging to the polygon, (see page 38), by the sum arising, by adding together the square of a side of each end, and the product of the two sides.



If the frustum be that of a cone, the mean area will be found by multiplying .2618 (or one third of .7854) by the sum arising, by adding together the squares of the two diameters and the product of the two.

Or, if the circumferences be used in like manner, instead of their diameters, the multiplier will be .02654, instead of .2618.

Example 1. Required the content of a pentagonal frustum, whose height is 4 feet, each side of the base 1 foot 6 inches, and each side of the lesser end 9 inches.

18 Side of the base   9 Side of lesser end   18 Side of the base.
18   Do.   9   Do.   9 Side the lesser end.

324 Square of base + 81 Squ. of small end + 162 Mean propor. = 567.

Now 567, the sum of the above, divided by 3, gives 189 :

And....1.720477 tabular and multiplier of the pentagon,
By.... .189   from above,

Gives 325.170153 the mean area.
This by   4.   height in feet,

Produces 1300.680612 : And this, successively divided by 12 and 12 = 144, gives 9.032 feet, the content of the frustum.

Example 2. Required the frustum of a cone, whose height is 37 inches, and the diameters of its ends 32 and 22 inches.

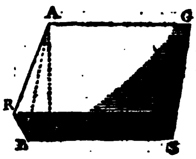
32 Greater diam.   22 Less diam.   32 Greater diam.
32   Do.   22   Do.   22 Smaller do.
  Sum.
1024 Sq. of lower dia. 484 Sq. of up. dia. 704 Mean proportional = 2212.

Now...... .2212 from above,
By........ .2168 constant Multiplier,

Produces 479.5616 Cubic inches, or 10.2683 cubic feet, the content.

Problem 7. *To find the Solidity of a Wedge.*

Rule. To the length of the edge add twice the length of the back or base, and reserve the sum ; multiply the height of the wedge by the breadth of the base ; then multiply this product by the reserved sum, and take one sixth of the last product for the content.

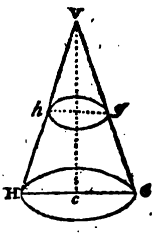


Example. Required the cubic content of a wedge whose height or altitude A L is 12 inches, its edge A G 18 inches; the length of its base B S 26 inches; and its breadth B R 4 inches.

18 Inches, length of edge.	Height 12 Inches.
26.....................base.	Breadth 4
26	—
—	Product 48
70	70
—	——
	6(3360(560 Inches the content.

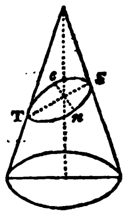
CONIC SECTIONS.

Conic Sections are figures which are formed by the intersection of a cone with a plane, either perpendicularly, horizontally, or obliquely; for, according to the different positions of the cutting plane, five different figures or sections are produced; namely, a triangle, a circle, an ellipse, a parabola, and an hyperbola. The three latter are, however, the only figures to which the term Conic Sections is properly applied.

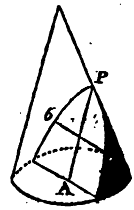


If the cutting plane pass through the vertex of the cone, and any part of the base, the section will be a *triangle* as V H G.

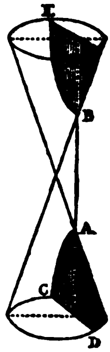
If the plane cut the cone parallel to the base, or make no angle with it, the section will be a *circle* as *h g*.



If the cone be cut obliquely through both sides, or if the plane be inclined to the base in a less angle than the side of the cone, the section is an *ellipse*, as T S *c n*.



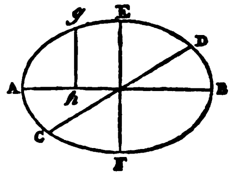
If the plane cuts the cone parallel to one side, or if the cutting plane and the side of the cone make equal angles with the base, the section is a *parabola*, as P A *b b*.



If the cutting plane makes a greater angle with the base than the side of the cone makes, the section is called an *hyperbola*, as A C D: and, if the plane be continued so as to cut an opposite cone, the latter is called the opposite hyperbola to the former, as B E.

The *vertices* of a conic section are the points where the cutting plane meets the opposite sides of the cone, or the sides of the vertical triangular section, as A and B. The ellipse and the opposite hyperbolas, therefore, have each two vertices; but the parabola only one; unless the other be considered as at an infinite distance.

The *axis* or *transverse diameter* is the line or distance A B between the vertices, and the middle point of the tranverse is the centre of the conic section.



A *Diameter* is any right line drawn through the centre, and terminated on each side by the curve: and the extremities of the diameter, or its intersections with the curve, are its vertices, as C D.

The *transverse diameter* of an *hyperbola* is that part of the axis intercepted between the vertices of the opposite sections.

The *conjugate axis* is a line, E F, drawn through the centre of the section and perpendicular to the transverse.

An ordinate is a line perpendicular to the tranverse axis, as *g h*.

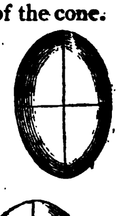
An abscissa is that part of the axis A *h*, between the ordinate and the vertex.

The *parameter* of any diameter is a third proportional to that diameter and its conjugate.

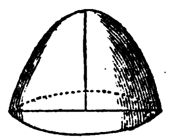
From these definitions it will appear, that the conic sections are in themselves a system of regular curves naturally allied to each other, and that one is changed into another by increase or diminution. Thus the curvature of a circle being ever so little increased or diminished passes into an ellipse. Also, the centre of the ellipse going off infinitely, and the curvature being thereby diminished, it is changed into the parabola: and again, the curvature of the parabola, being ever so little changed, produces the first of the hyperbolas; the innumerable species of which will all arise in gradation by a diminution of the curvature, until at length, the last hyperbola will end in a right line. Whence it is manifest, that every regular curvature, like that of the circle, from the circle itself to a right line, is a conical curvature, and distinguished with its peculiar name, according to the degree of curvature.

In short, a circle may change into an ellipsis, the ellipsis into a parabola, the parabola into an hyperbola, and the hyperbola into a plane isosceles triangle. And the centre of the circle, which is its focus, divides itself into two foci, so soon as the circle begins to degenerate into an ellipsis: but when the ellipsis changes into a parabola, one end of it flies open, one of its foci vanishes, and the remaining focus goes along with the parabola until the latter degenerates into an hyperbola. And, when the hyperbola degenerates into a plane isosceles triangle, this focus becomes the vertical point of the triangle, namely the vertex of the cone. So that the centre of the base of the cone may be said to pass gradually through all the sections until it arrive at the vertex.

As the science of conics is of the highest utility in the theory and practice of naval architecture, we have entered the more fully into an explanation of "*Conic Sections*." For, from the segments of circles, and various elliptical curves, are formed the moulds used for constructing the draughts and plans of ships; to which may be added, that the bows of all vessels are, or should be, constructed from the properties of the cone.



A *Spheroid* or *Ellipsoid*, is a solid generated by the revolution of an ellipse about one of its axes. It is a prolate spheroid, when the revolution is made about the transverse axis; and an oblate one, when about the conjugate axis.

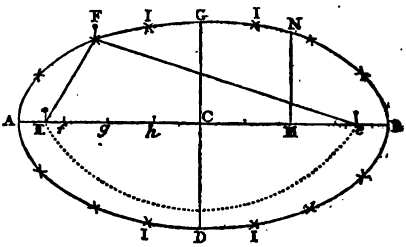


A Conoid is a solid formed by the revolution of a parabola or hyperbola about the axis. It is accordingly called either a parabolic or hyperbolic conoid. The former is also called a paraboloid, and the latter an hyperboloid.

A spindle is formed by any of the three sections revolving about a double ordinate, like the circular spindle.

A *Segment* of either of the conic solids is a part cut off at the top by a plane parallel to the base; and a *Frustum* is the part left next the base after the segment is cut off.

PROBLEM 1. *To describe an Ellipse or Ellipsis.*



Let A B be the transverse, G D the conjugate, and C the centre. With the radius A C and centre G, describe an arc cutting A B in the points E, *e*; which are called the foci of the ellipse.

Now assume any point *g* in the tranverse, and with the radii *g* A, *g* B, and centres E *e*, describe two arcs intersecting in F, which will be a point in the curve of the ellipse. And thus, by assuming a number of points *f*, *h*, in the transverse, may as many points in the curve be found as are required. Then, with the edge of a mould, or a steady hand, draw a curve through all these points.

Or, otherwise, take a thread of the length of the transverse, and fasten its ends with two pins in the foci E, *e*. Then stretch the thread, and it will reach to F in the curve: and, by moving a pencil round, within the thread, keeping it always stretched, it will trace out the ellipse.

PROBLEM 2. *To find the Length of the Elliptic Curve.*

RULE. Multiply the sum of the transverse and conjugate diameters by 1.5708, and the product will be the circumference very nearly.

EXAMPLE. Required the length of an elliptic curve, whose conjugate is 40, and transverse 60 feet.

Conjugate	40	Constant Multiplier	1.5708
Transverse	60		100
Sum	100	Product	157.08 Answer.

PROBLEM 3. *To find the Area of an Ellipse.*

RULE. Multiply the transverse by the conjugate, and the product by .7854 for the area. Or, multiply .7854 by the one axis and the product again by the other.

EXAMPLE. Required the area of an ellipse, whose transverse and conjugate are 48 and 36 feet.

Conjugate	36	Or, Multiplier	.7854
Transverse	48	Conjugate	36
	1728		28.2744
Multiplier	.7854		48
	1357.1712 Area		1357.1712 Area.

PROBLEM 4. *The Transverse, Conjugate, and Ordinate of an Ellipse being given, to find the Abscissas.*

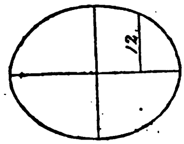
RULE. From the square of half the conjugate subtract the square of the ordinate; and extract the square root of the remainder. Then say,

As the conjugate is to the transverse

So is that square root to half the difference of the abscissas.

Then add this half difference to half the transverse for the greater abscissa; and subtract it for the less.

EXAMPLE. What are the two abscissas to the ordinate 12, the axes being 40 and 30?



Transverse ... 40, one half is 20
Conjugate .... 30, the square of ½ (15) is 225
Ordinate...... 12, the square is 144

$\sqrt{81}=9$. Difference ... 81

Now as 30 : 40 :: 9 : 12. Therefore 20 and 20
12 12

Longer Abscissa 32 Shorter 8

PROBLEM 5. *The Conjugate, Ordinate, and Abscissa of an Ellipse being given, to find the Transverse.*

RULE. From the square of half the conjugate subtract the square of the ordinate; and extract the root of the remainder. Next, add this root to the half conjugate, if the less abscissa be given, but subtract it when the greater one is given, reserving the sum or difference. Then use the following proportion.

As the square of the ordinate
Is to the product of the conjugate and abscissa,
So is the sum or difference, found as above,
To the transverse.

EXAMPLE. The conjugate 30, the ordinate 12, and the abscissa 18 given; required the transverse.

Conjugate 30, the square of one half is 225
Ordinate 12, the square is 144

Difference ... 81 the root is 9.

Half-conjugate 15+root 9=24. And conjugate 30 × abscissa 18=540. Then as 144 : 540 : : 24 : 90; the required transverse.

PROBLEM 6. *The Transverse, Ordinate, and Abscissa, of an Ellipse being given, to find the Conjugate.*

RULE. As the square root of the product of the two abscissas
Is to the ordinate,
So is the transverse
To the conjugate.

EXAMPLE. The transverse 90, the ordinate 12, and the abscissa 18, being given; required the conjugate diameter?

90—18=72; and 72 × 18=1296, of which the root is 36.
Therefore, as 36 : 12 :: 90 : 30, the required conjugate.

PROBLEM 7. *The Abscissa, Transverse, and Conjugate of the Ellipse being given, to find the Ordinate.*

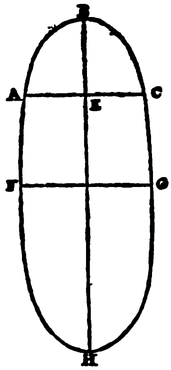
RULE. As the transverse
Is to the conjugate,
So is the square root of the product of the two abscissas
To the ordinate.

EXAMPLE. The transverse 90, the abscissa 18, and the conjugate 30 given, required the ordinate.

As 90 : 30 :: ($\sqrt{72 \times 18}$ or $\sqrt{1296}$) 36 : 12 the required ordinate.

PROBLEM 8. *To find the Area of an Elliptic Segment, whose base is parallel to either of the Axes.*

RULE. Divide the height of the segment by that axis of the ellipse of which it is a part; and find, in the table of circular segments inserted hereafter, a circular segment, having the same versed sine (or height) as this. Multiply the area so found, and the two axes successively, and the last product will be the required area of the segment.



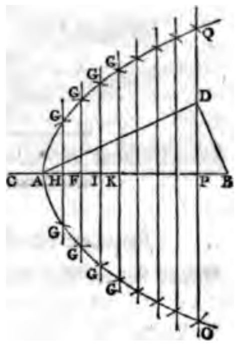
EXAMPLE. Required the area of the elliptic segment A B C, whose height B E is 20, and the axes F G, B H, 40 and 90.

20÷90=.222; the number corresponding to which in the table is .129773

Multiply by	40	conjugate
	5.190920	
	90	transverse
Product	467.1828	required area.

If great nicety be required, the proportional parts between the two nearest of the tabular heights should be taken.

PROBLEM 9. *To describe or construct a Parabola.*



A P being an abscissa, and P Q its given ordinate, bisect P Q in D; join D A, and draw D B perpendicular to it. Then transfer P B to A F and A C in the axis produced. F will then be what is called the *focus*.

Now draw several double ordinates, G H G, G F G, &c. and with the radii C A, C H, &c. and from F, as a centre, describe arcs, cutting the corresponding ordinates in the points G G, &c. through which the curve is to be drawn.

The line G F G is called the *parameter*.

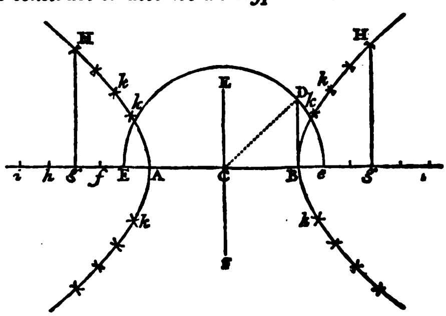
PROBLEM 10. *To find the Area of a Parabola.*

RULE. Multiply the base by the height, and take two-thirds of the product for the area; every parabola being equal to $\frac{2}{3}$ of the circumscribing parallelogram.

EXAMPLE. What is the area of a parabola, whose height is 12 and base 18.

18 × 12=216; two-thirds of which is 144, the area.

PROBLEM 10. *To construct or describe an Hyperbola.*



Let C be the centre of the hyperbola, or the middle of the transverse A B; and B D perpendicular to A B, and equal to half the conjugate.

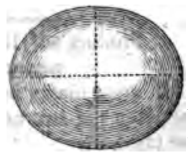
From C, as a centre, with radius C D, describe an arc meeting A B produced in E and *e*, which are the two foci of the hyperbola.

Then, assuming several points, as $f\,g\,h\,i$, in the transverse produced, with the radii Af, Bf, Ag, Bg, &c. from $E\,e$, as centres, describe arcs intersecting in the several points k, through which the hyperbolic curve is to be drawn.

PROBLEM 11. *To find the Solidity of a Spheroid.*

RULE. Multiply the square of the revolving axis by the fixed axis, and multiply the product by .5236 for the solid content.

EXAMPLE. Required the content of a prolate spheroid, the transverse or fixed axis of which is 45, and its revolving axis 35.

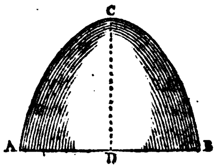


	35	
	35	
	1225	square of revolving axis.
Multiplied by	45	fixed axis.
Product.....	55125	
	.5236	constant multiplier.
Solid Content	28863.4500	

PROBLEM 12. *To find the Solidity of a parabolic Conoid.*

RULE. Square the diameter of the base, multiply that by the height, and the product again by .3927, for the solidity.

EXAMPLE. Required the solidity of the paraboloid, whose height C D is 35, and the diameter of its base 45?



45	
45	
2025	square of the base
35	height
70875	product
.3927	constant multiplier
27832.6125	the solidity of the paraboloid.

SECTION III.

OF THE

SPECIFIC GRAVITY OF BODIES.

By Specific Gravity is meant the comparative difference in the weight or gravity of two bodies of equal bulk; hence called also relative or comparative gravity, because we judge of it by comparison.

The absolute gravity of a body is the force with which it tends downwards; and is always proportional to the density of the body without any regard to its magnitude; so that a pound of cork is as heavy as a pound of gold. But the specific gravity of bodies are their relative weights under the same magnitude, and are proportional to their density. Thus a cubic foot of lead is heavier than a cubic foot of fir; for lead, being more dense than fir, contains, under the same bulk, a greater quantity of matter.

LAWS OF THE SPECIFIC GRAVITY OF BODIES.

1. If two bodies be equal in bulk, their specific gravities are to each other as their weights, or as their densities.
2. If two bodies be of the same specific gravity or density, their absolute weights will be as their magnitudes.
3. In bodies of the same weight, the specific gravities are reciprocally as their bulks.
4. The specific gravities of all bodies are in a ratio compounded of the direct ratio of their weights and the reciprocal ratio of their magnitudes. And hence, again, the specific gravities are as the densities.
5. The absolute gravities or weights of bodies are in the compound ratio of their specific gravities and magnitudes or bulks.
6. The magnitudes of bodies are directly as their weights, and reciprocally as their specific gravities.
7. A body specifically heavier than a fluid, loses as much of its weight when immersed in it, as is equal to the weight of a quantity of the fluid of the same bulk or magnitude.

Hence, since the specific gravities are as the absolute gravities under the same bulk; the specific gravity of the fluid will be to that of the body immersed, as the part of the weight lost by the solid is to the whole weight.

And hence the specific gravities of fluids are as the weights lost by the same solid immersed in them.

In the following table of specific gravities, the numbers express the number of avoirdupois ounces in a cubic foot of each body; that of common or rain water being just 1000 ounces. To determine, therefore, the specific gravity of any substance heavier than water, weigh any given quantity of that substance in air, in a common balance, and afterwards weigh it in water, carefully noting its loss of weight; divide its whole absolute gravity, or weight of the substance in air by its loss of weight in water, and you will have its true specific gravity.

A TABLE OF SPECIFIC GRAVITIES.

Lead	11325	Ebony	1177	Rain Water	1000
Fine Copper	9000	Pitch	1150	Oak	925
Gun Metal	8784	Rosin	1100	Ash	800
Fine Brass	8350	Mahogany	1063	Beech	700
Iron from 7827 to	7645	Box Wood	1030	Elm	600
Cast Iron	7425	Sea Water	1030	Fir	548
Sand	1520	Tar	1015	Cork	240
Lignum Vitæ	1327	River Water	1009	Common Air	1.232

These numbers being the weight of a cubic foot, or 1728 cubic inches, of each of the bodies in avoirdupois ounces; by proportion, the quantity in any other weight, or the weight of any other quantity, may be readily known.

Problem 1. *To find the Magnitude of any Body from its Weight.*

Rule. As the tabular specific gravity of the body
Is to its weight in avoirdupois ounces,
So is one cubic foot, or 1728 cubic inches,
To its content in feet or inches, respectively.

Example 1. Required the content of an irregular piece of dry oak, which weighs 234*lb.* or 3744*oz.*?

Sp. gr. oz. Oz. Cub. In. Cub. In.
As 925 : 3744 :: 1728 : $6994\frac{4}{5}$ or 4 feet 8 inches, the cubic Content.

Example 2. How many cubic feet are there in a ton weight of dry elm, of which the specific gravity is 600 *oz.* or $37\frac{1}{2}$*lb.*?

lb. lb. in a ton. ft. ft.
$37\frac{1}{2}$: 2240 :: 1 : 59.73, the Content.

Problem 2. *To find the Weight of a Body from its Magnitude.*

Rule. As one cubic foot, or 1728 cubic inches,
Is to the content of the body,
So is its tabular specific gravity
To the weight of the body.

Example. Required the weight of a piece of dry fir timber, 25 feet long, and 1 foot 6 inches square?

The length 25 *ft.* × 1 *ft.* 6 *in.* × 1 *ft.* 6 *in.* = 56 *ft.* 3 *in.* the Content.

ft. ft. Tab. gr.
Therefore, as 1 : $56\frac{1}{4}$ :: 550 : the weight; or 1934 *lbs.* = 17 *cwt.* 30*lbs.*

Problem 3. *To find the Specific Gravity of a Body.*

1. If the body be heavier than water, weigh it both in water and out of water, and take the difference, which will be the weight lost in water. Then state the question thus;

As the weight lost in water
Is to the whole weight,
So is the specific gravity of water
To the specific gravity of the body.

A piece of fine copper weighed 9*lb.* but in water only 8*lb.* Required its specific gravity?

As 1 *lb.* : 9 *lb.* :: 1000 *oz.* (the spec. grav. of water) : 9000 *oz.* the spec. grav. required.

2. If the body be lighter than water, so that it will not wholly sink, affix to it a piece of another body heavier than water, so that the whole may sink together. Then weigh them both together and separately, in water and out of it. Next find how much each loses in water, by subtracting its weight in water from its weight when out of it. Subtract the lesser of these remainders from the greater; then say,

As the last remainder
Is to the weight of the light body in air,
So is the specific gravity of water
To the specific gravity of the body.

Suppose a piece of cork weighs 25*lb.* in air, and that a piece of lead, which weighs 100*lb.* in air and 91.17 in water is affixed to it; and that the compound weighs 12*lb.* in water. Required the specific gravity of the cork.

Lead.		*Compound.*
100	in air	125
91.17	in water	12
8.83		113
		8.83

Then, as the last remainder .... 104.17 : 25 :: 1000 : 240, the specific gravity required.

DESCRIPTION OF THE SLIDING RULE

GENERALLY USED BY

SHIPWRIGHTS AND MASTMAKERS;

WITH

OBSERVATIONS UPON TIMBER,

AND

RULES FOR ITS ADMEASUREMENT, &c. &c.

THE sliding rule is generally made of box-wood, and consists of two pieces, or legs, each of twelve inches in length, which are connected together by a folding joint. Upon its surfaces and edges are engraved lines graduated into fractional portions, &c. particularly adapted to ship-building, carpentry, mastmaking, &c.

On the one side are twenty-four inches, subdivided into halves, quarters, and eighths. Between this line of inches, when the rule is shut, are contained either several plane scales, subdivided into twelfth parts, which are used in planning dimensions that are taken in feet and inches; or, fractional proportions of the different diameters of masts, &c. at their quarters, heads, and heels, as they bear to the given diameter at the partners.

On the other side are contained a Gunter's line, (or a line of numbers) marked A; the slide, whose two edges are marked B and C; the inverted line, marked D; and the girt line, E. This side likewise contains either a table shewing the value of a load, or fifty cubic feet, of timber, at all prices, from sixpence to two shillings per foot; or, otherwise, proportions for finding the lengths and diameters of all masts, yards, &c.

The outside edge, supposing the rule open, is divided into 200 equal parts, for the more readily finding the decimal of inches and their parts, and for use occasionally as a scale of equal parts. Thus, as to the readily finding the decimal of any given number of inches, suppose it were wanted for 7½ inches; against 7½ inches will be found, on the outer edge, a corresponding division of 62½, which, decimally expressed, is .625.

On the inside edges are two divisions of lines, which may be used indifferently for the same purpose, namely, the eight-squaring of a four-sided piece. The one is marked E, signifying *Edge*, and the other M, for *Eight-square from the Middle Line**. They are thus used: Take with compasses, from either of these edges, as many divisions and their

* These lines are not given on the common sliding rule; but they will always be found on Steel's Improved Rule, for the use of Mastmakers and Shipwrights.—See "*The Art of making Masts*," &c. published by P. STEEL, Little Tower-hill, London, and intended as an accompanying volume to the present work.

parts as the diameter of the four-sided piece has inches and parts, and set off that distance from the four sides, if the line marked *Edge* was used; or from the middle of each side, if the line marked *Eight-square* was used. The angles being taken off to those points will leave an octagon, or eight-square piece.

DESCRIPTION AND USE OF THE GUNTER'S LINE.

The upper line, marked A, is the Gunter's line, or double line of numbers, logarithmically divided; and, under it, a slider, divided in the same manner on both of its edges, the upper edge marked B, the lower edge C: by moving which slider, problems are solved instrumentally, in the same manner as by logarithms arithmetically.

It is divided into a hundred parts; every tenth whereof is numbered, beginning with one and ending with ten: so that, if the first great division, marked 1, stands for one tenth of any integer; the next division, marked 2, will stand for two-tenths; 3, three-tenths; and so on: and the intermediate divisions will, in like manner, represent one-hundredth parts of the same integer. If each of the great divisions represent ten integers, then will the lesser divisions stand for integers; and, if each of the greater divisions represent a hundred integers, the subdivisions will be each ten; if thousands, then hundreds, &c.

The line being thus constructed, it will be easy to find any number upon it: and, that it may be done with expedition, where the spaces are divided into ten parts betwixt the figures, every fifth is distinguished by longer strokes than the tens. Now the value of these strokes is determined by the value of the figures, as before-mentioned; which being arbitrary, their value must be determined before any number upon the line can be ascertained. If the number be less than 100, 1 at the left-hand end may be unity, then 1 in the middle will be 10, 1 at the right-hand end 100. The strokes, representing the tens in the first great division, will be the tenths of units; and those in the next great division will be units. The short strokes between the tens are estimated according to their number: where there are 9 intermediates, each will be one-100th part of an unit in the left-hand division, and one tenth of an unit in the right-hand division. If there be only four intermediate strokes, each will be two-100th parts or two-10ths of unity: and, if there be but one stroke, it will be five-100th parts or five-10ths of unity.

If 4 were required, look for that figure in the left-hand division: if 20, it will be at 2 in the right-hand division; if 4½ or 4.5 count 5 strokes beyond the figure 4 in the left-hand division; if 400 were required, the first 1 at the left must be accounted 10, the next 1 a hundred: so, figure 4 in the right-hand division will be 400; 430 will be three strokes beyond figure 4; 435 will be in the middle betwixt the third and fourth stroke beyond figure 4; if 433, a little more than one-quarter of the space betwixt the third and fourth stroke must be taken.

MULTIPLICATION BY THE LINE OF NUMBERS.

RULE. Place 1, on the slide, under either of the given numbers; then, above the other given number on the slide, towards the right hand on the rule, is the product.

EXAMPLE. Multiply 7 by 5. Set 1, upon the line B, to 5, upon the line A; then, over 7, upon the line B, is 35, the product sought upon A.

EXAMPLE. Multiply 98 by 8. Here, 98, when 1 to 8 on the first division are only considered as units, would reach beyond the end of the line; therefore, 1 at the beginning of the line must be accounted 10; so, 98 will be found in the first division: then, set 10, on the line B, under 80, in the first division on the line A, and over 98, upon the line B, is 784, the product required upon A. When the slide is thus set, we have the product of any number, multiplied by 8; for, above 20 is 160, above 50 is 400, above 120 is 960; and, as 200, on the slide, goes beyond the line upon the rule, in this and the like cases, the value of the figures, as observed before, must be altered; and 1 at the beginning must be 100; then, above 2 or 200, we have 1600 the product.

DIVISION BY THE LINE OF NUMBERS.

THIS is only the reverse of multiplication; for, set the divisor, on the slide, against 1 on the rule; and, against the dividend, on the slide, the quotient will be found upon the rule.

EXAMPLE. Let 48 be divided by 8. Set 8, upon the slide, against 1 upon the middle of the line A; and, above 48, upon the slide, is 6, upon the line A, the quotient sought. In this position, without moving the slide, the quotient of any number divided by 8 is readily seen.

Hence, to reduce a vulgar fraction into a decimal, add a cipher to each part of the fraction; and, if the denominator, upon the slide, is set against 10, upon line A, then, above the numerator upon the slide, will be found the decimal fraction upon the line A. Thus, the vulgar fraction $\frac{6}{8}$ or $\frac{60}{80}$ will be found to be .75 in decimals.

RULE OF THREE BY THE LINE OF NUMBERS.

RULE. Set the first term, upon the slide, against the second term, upon the line A; and, above the third term, upon the slide, will be found the fourth term sought, upon the line A.

EXAMPLE. Suppose 50 feet of timber (or one load) cost 65 shillings, what will 270 feet (or 5 loads 20 feet) come to. As 50 : 65 : : 270 : 351.

Set 50, upon the slide, under 65, upon A: then, above 270, upon the slide, is 351, upon A, the value of 270 feet of timber. It is indifferent whether the first term be taken on the slide or on the rule, provided the third term be taken on the same line as the first. Neither is it material which of the means is taken for the second term, for, as 50 : 270 : : 65 : 351.

But, as the answer to the above and similar questions is sometimes required in pounds, this must again be divided by 20; and the operation by arithmetic would be $351 \div 20 = 17l.\ 11s.$ By the rule, 1, on the slide, is placed under 20, or figure 2, in the first division of the line A; then, under 351, upon the same line, is, upon the line B, 17, and 3 of the small divisions nearly, which are fifths, each of which in this case must be reckoned 4s. so that 17 and almost 3-fifths will be 17*l.* 11*s.* or, as 50 : 3*l.* 5*s.* : : 270 : 17*l.* 11*s.* Place 50, or figure 5, upon the slide, under 3 and

2½ tenths, upon line A, =5s. then above 270, upon the slide, is 17 and 3-fifths nearly of a pound, upon the line A.

Example. What is the ⅕ of 64? As the ⅕ of 8 is 5, say, by the rule of three, if 8 gives 5, what will 64 give? The answer will be 40: for, as 8 : 5 : : 64 : 40.

OF MEASURING PLANK.

All plank is considered as an oblong square, and measured as a plain surface, without any regard to its thickness; and all the varieties thereof may be reduced to the Rule of Three by the following proportions.

As 1 : length in feet : : breadth in feet:
As 12 : length in feet : : breadth in inches: } area in feet.
As 144 : length in inches : : breadth in inches:

Example. Let there be 3 planks of the following dimensions.

ft. Broad.	ft. Long.	Length.	Breadth.	Area.		
20	11	as 1 : 20 : :	.92 nearly :	18 4	or, as 12 : 20 : : 11 : 18 4	or, as 144 : 240 : : 11 : 18 4
30	15	as 1 : 30 : :	1.25 nearly :	37 5	or, as 12 : 30 : : 15 : 37 6	or, as 144 : 360 : : 15 : 37 6
15	18	as 1 : 15 : :	1.5 nearly :	22 5	or, as 12 : 15 : : 18 : 22 6	or, as 144 : 180 : : 18 : 22 6

Here every example is done three different ways, containing nine different questions in the Rule of Three. Their solutions will be found as before directed; for, if 1, at the beginning of the slide, be accounted 1-tenth, 1 in the middle will be unity. If, then, this 1, in the middle of the slide, be set against 20, upon the line A, then will .92 nearly be against 18 feet 4 inches. As the breadth, in the first question, is less than one foot, the decimal of 11 inches must be taken from the outside edge of the rule, which will be found to be .92 nearly: or, if 12 be set under 20, then over 11 will be 18 feet 4 inches, which is the general way of measuring plank: or, if 144 be set under 240, then above 11 will be 18 feet 4 inches. The same may be said of all the rest.

Though all plank is measured as a surface, the value is estimated by the load, which is 50 feet solid. The following proportion will serve to find how many superficial feet of plank will make a load, viz. as the inches thick : 12 : : 50 (the solid feet in a load) : the superficial feet.

Example. How many superficial feet of 2, 3, 4, 5, 6, inches plank will make a load?

Set 2, upon the slide, under 12, upon A; then will 5 or 50, on the line B, be under 3 in the next division, or 300, upon the line A; and so for the others, as 2 : 12 : : 50 : 300 | as 3 : 12 : : 50 : 200 | as 4 : 12 : : 50 : 150 | as 5 : 12 : : 50 : 120 | as 6 : 12 : : 50 : 100.

Hence it may be found, that the number of superficial feet to a load of thickstuff or plank, from 10 inches to 1½ inch in thickness will be as follows:

	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Thickness	10	9	8	7	6	5	4	3	2½	2	1½
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
In a load	60	66.66	75	85,71	100	120	150	200	240	300	400

OF MEASURING SQUARED OR SIDED TIMBER IN GENERAL.

FIND a superficial content, as if it was plank: this multiplied by the thickness in inches, and the product divided by 12, the quotient will be the content in feet. So, to both operations, the proportions are,

1st. As 12 : length in feet : : breadth in inches : area in feet.

2d. As 12 : area in feet : : thickness in inches : contents in feet.

Or, as 1 : breadth in inches : : thickness in inches : a fourth number.

And, as 144 : fourth number : : length in feet : contents in feet.

That is, multiply the breadth by the thickness, if both be inches, and the product by the length in feet; divide the last product by 144, the quotient will be the length in feet.

EXAMPLE. Required the content of a piece of timber 30 feet long, 21 broad, and 25 inches thick.

1st. as 12 : 30 0 : : 21 : 52 6 or, as 1 : 21 : : 25 : 525 0
Then, as 12 : 52 6 : : 25 : 109 4½ or, as 144 : 525 : : 30 : 109 4½

By the line of numbers, the slide must be drawn twice: first, 12, on the slide, set under 30, upon A; then, 21 will be under 52.5, upon A: secondly, 12 under 52.5 and over 25 will be 109.5, upon A. This is quite near enough; as, in measuring timber contents, nothing less than ½ a foot or .5 is used: or 1 placed under 21, upon A, over 25, will be 525; and, if 144 be placed under 525, over 30, will be 109.5, nearly as before. There is no necessity to account the value of the fourth proportionals to the three first numbers; for, if a small mark be made with a pencil, so as the slide may be moved till 12 or 144 be under, it will answer the same: but as an inconveniency may attend this, make use of the inverted line, which performs the operation by once moving the slide.

DESCRIPTION AND USE OF THE INVERTED LINE D *.

THE slide moves between two double lines of numbers, of which the lower one is inverted in such a manner, that 12 upon the slide is exactly over 12 upon the inverted line, marked at the end D; so, 50, 60, &c. upon the inverted line, are as much to the left hand of the point 12 as 50, 60, &c. &c. are to the right hand of the point 12 upon the line A. In expressing the inverted line, we begin at the right hand; and, because the distance between 1 and 12 is more than that betwixt 12 and 100, the inverted line begins at 1.4, for 1 would extend beyond the end of the rule.

The slider having two double lines of numbers, graduated exactly as the line A, whatever way the slide is moved, the point 12 upon A, and the point 12 upon the line C will be both against the same number.

TO MEASURE TIMBER BY THE INVERTED LINE, WHEN THE BREADTH AND THICKNESS ARE UNEQUAL AND BOTH GIVEN IN INCHES, AND THE LENGTH IN FEET.

RULE. Place either the breadth or thickness upon the slide; suppose the thickness 25 inches, to 21 inches, the breadth, upon the inverted line;

* This line is not introduced on the common sliding rule. The girt line on that rule is generally marked D.

then, under the length, suppose 30 feet, upon the line A, is 109.5 nearly, upon the line B, the contents.

EXAMPLE. Suppose a piece of timber 20 feet long, 18 inches broad, and 15 inches thick: set 18, upon the slide, line C, over 15 on the inverted line; and, under 20, upon the line A, is 37½, the contents upon the line B.

DESCRIPTION AND USE OF THE SINGLE LINE, COMMONLY CALLED THE GIRT-LINE, E.

THE single line, called the girt-line, is marked E, and its radius is equal to two radii of any of the other lines: it is broke for the easier measurement of timber, and figured 4, 5, 6, 7, 8, 9, 10, 20, 30, &c. From 4 to 5 it is divided into 10 parts, and so on from 5 to 10, thence to the end into fourths and quarters.

TO FIND A MEAN PROPORTIONAL BETWEEN ANY TWO GIVEN NUMBERS.

RULE. Set one of the given numbers upon C over the same number upon E; and then, under the other given number upon C, is the geometrical mean sought upon E.

EXAMPLE. Let the numbers given be 29 and 43, set the one number 29 on C to the same number on E; then, under the number 43 on C stands their mean proportional 35.3 on E, the mean sought.

TO SQUARE ANY NUMBER BY THE RULE.

SUPPOSE it be required to square 23. Set 1 on B to 23 on A; then, against 23 on B stands 529 on A, which is the square of 23.

TO EXTRACT THE SQUARE ROOT BY THE RULE.

SET the middle division on the line marked C to 10 on the line E; then, if the given number consists of 2, 4, or 6, places of figures, it is to be found on the first, or left hand, half of the line C; but if it consists of 3, 5, or 7 figures, it is to be found on the right hand part of the line; opposite to which, on the line E, is the square root required.

EXAMPLES. 1. Required the square root of 64?

The middle division, or 1 on the slide, being placed against 10 on the line E; then, opposite to 64 on the first part of C, is 8 the square root required.

2. Required the square root of 121?

The slide being placed as before, then opposite 121, on the second part of the slide, is 11, its square root, on the line E.

TO MEASURE UNEQUAL-SIDED TIMBER BY THE GIRT-LINE.

RULE. Set 12, upon the girt-line E, to the length on the line C, and, over the mean, upon the line E, are the contents upon C.

EXAMPLE. Let the length of a piece of timber be 13 feet, the breadth 23 inches, and the depth 13 inches. Seek the mean as above, and there make a fine pencil stroke; then set 12 upon the line E to 13 feet, the length, upon C; and, over 17.35, or fine stroke, upon E, is 27 feet, the contents.

TO MEASURE TAPER TIMBER.

Rule. The length being measured in feet, note one-third of it, which is found thus: set 3, on the line A, to the length, upon the line B; then, under 1, upon A, is the third part upon B. Then, if the solid be round timber, measure the diameter at each end in inches, and subtract the less diameter from the greater, add half the difference to the less diameter, the sum is the diameter in the middle of the piece. Then, set 13.54 on the girt to the length on the line C; and, over the middle diameter, on the girt, is a fourth number on the line C. Again, set 13.54, on the girt-line, to the third part of the length, on the line C; then, against half the difference on the girt-line, is another fourth number, upon the line C: these two fourth numbers added together give the contents.

Example. Suppose the length to be 27 feet, (one-third whereof is 9), the greater diameter 22 inches, and the lesser 18, the sum of the two will be 40, their difference 4, and half-difference 2. The half-difference 2, added to the less diameter, gives 20 inches for the diameter in the middle.

Now, set 13.54, on the girt-line, to 27, on the line C; and, over 20, upon the girt, is 58.9 feet. Again, set 13.54, on the girt-line, under 9, upon the line C; and, over 2, upon the girt-line, (represented by 20.) is .196 parts; therefore by adding 58.9 feet to .196 feet, the sum is 59.096 feet, the contents.

If the timber be square, and have the same dimensions; that is, the length 27 feet, the side of the greater end 22 inches, and that of the lesser end 18 inches: to find the content, set 12, upon the girt-line, to 27, the length upon C; and, over 20 inches, the side of the mean square, on the girt-line, is 75.4 feet, upon C. Again, set 12, upon the girt-line, to 9 feet, one-third of the length, upon the line C; and, over 2 inches, half the difference of the sides of the squares of the ends, on the girt-line, is .25 parts of a foot, both together make 75.65 feet, the content of the solid.

The girt, or circumference, of a tree or round piece of timber given, to find the side of the square within, or the number of inches of a side, when the round timber is squared.

Set 10, upon A, to 9, upon B; then, against the girt, or circumference, on A, are the inches for the side of a square, on the line B.

OF MEASURING TIMBER, &c.

Timber is generally divided into the following classes; viz. Rough timber, square or hewn timber, sided timber, thickstuff, and plank. By rough timber is understood timber of the full size of the tree, as it grows, without the lop, top, and bark (unless the timber is bought standing); if so, it is generally sold by the lot, and then the buyer can only be guided by his judgment, both in regard to the quality and quantity.

Rough timber may be kept in piles, shedded over, without injury, for six years or more; it is nevertheless certain, that timber, in all situations, may be kept in a state of seasoning too long.

When timber is converting, it should be spread about as much as possible, that the moulds may be the more readily applied on the most suitable pieces. By which great saving of timber will be made in the conversion. This practice might also be of great advantage in point of strength to the ship; as there would be no occasion to use any timber but such as is of proper size and growth. The French have long made it a practice to convert the timber in the place where it grows; a practice much to be recommended here, particularly in some inland counties, where there are many fine oaks, not purchased for ship-building, owing to the great expense of carriage.

N. B. Winter felled timber is always to be preferred to that felled in other seasons; but to this may be attached the extra expence of barking the tree standing.

All timber is bought and sold by the load, and a load is fifty feet, which is supposed to weigh a ton, or twenty hundred weight; but some reckon forty feet of rough or unhewn timber to the load; for they say, that, as hewn timber is measured by the square, it is very nearly exact; but rough timber, being measured by the girt (or quarter compass), which is more than one-fifth less than exact, therefore, in the buying and selling of timber, it amounts to much the same, whether it is measured to the girt, at forty feet solid to the load, or measured exactly at fifty feet to a load, the price being in proportion. In the King's yards forty feet of hewn timber is reckoned a ton, and fifty feet of such timber goes to a load.

TO MEASURE AND COMPUTE THE SOLIDITY OF ROUND OR ROUGH TIMBER, WHEN THE TREE IS STRAIGHT, AND THE ENDS EQUAL OR NEARLY SO.

RULE 1. OR COMMON RULE.

MULTIPLY the square of one-fourth of the circumference by the length, and the product will be the solidity, or the contents.

The circumference is taken by a leather strap, or a tape, a small cord, or line; and that circumference, divided into four, is termed the girt: this is considered as though it was the side of a square, whose area is agreeable to the section of the tree at that place where it was girted.

EXAMPLE. What is the solid content of a tree, whose circumference is 64 inches, and the length 24 feet?

One-fourth of 64 is 1 foot 4 inches, which, multiplied by 1 foot 4 inches, is equal to 1 foot 9 inches, and 4 twelfths or seconds.

Then 1 foot 9 inches and 4 seconds, multiplied by 24 feet, is equal to 42 feet 8 inches, the solidity.

BY THE SLIDING RULE.

As the length upon C : 12 or 10 upon E : : quarter girt, in 12ths or 10ths, on E : the content on C.

NOTE 1. But, if the tree should not be straight, then the length must neither be taken on the concave or convex side, but in the middle.

TO MEASURE AND COMPUTE THE SOLIDITY OF ROUND OR ROUGH TIMBER WHEN THE TREE TAPERS, OR IS UNEQUALLY THICK.

RULE 2. When the tree is tapering, gird in the middle, for the mean girth, or, gird it at the two ends, and take half the sum of the circumference of the two. But, when the tree is very irregular, gird it in as many places as are thought necessary, and find the contents of each part separately: or else, add all the girths together, and divide the sum by their number; which gives (as supposed) the mean circumference: the fourth of which, squared and multiplied by the length, gives the solid contents.

EXAMPLE. A tapering tree is girt in four places, the girths being as follow: first, 3 feet 9 inches; second, 4 feet 5 inches; third, 4 feet 9 inches; and fourth, 5 feet 9 inches: the length being 20 feet, what is the solidity?

To 3 feet 9 inches add 4 feet 5 inches, add 4 feet 9 inches, add 5 feet 9 inches; the sum is equal to 18 feet 8 inches; this, divided by 4, is equal to 4 feet 8 inches, the mean compass.

Then 4 feet 8 inches, divided by 4, is equal to 1 foot 2 inches; multiplied by 1 foot 2 inches, is equal to 1 foot 4 inches 4-twelfths; 1 foot 4 inches 4-twelfths, multiplied by 20, is equal to 27 feet 2 inches and 8-twelfths, the solidity.

NOTE 2. This rule, which is commonly used, gives the answer about one-fourth less than the true quantity would be after the tree is hewed square in the usual way; so that it seems intended to make an allowance for the squaring of the tree. When the true quantity is desired, use the following rule.

TO MEASURE AND COMPUTE THE TRUE SOLIDITY OF ROUND OR ROUGH TIMBER.

RULE 3. Multiply one-fifth of the mean girth by double the length, and the product will be the content very nearly.

EXAMPLE. What are the true solid contents of a tree, whose circumference is 64 inches, and the length 24 feet?

One-fifth of 64 is 12. 9. 7, which, multiplied by 48 feet, is equal to 50 feet 7 inches 8 parts, the true solidity.

BY THE SLIDING RULE.

As the double length on C : 12 or 10 on E : : 1-fifth of the girt, in 12ths or 10ths, on E : the contents on C.

TO MEASURE AND COMPUTE THE SOLIDITY OF SUCH TREES AS HAVE THEIR BARK ON.

IN measuring such timber for sale, it is common to make an allowance or deduction to the buyer on account of the bark, which is generally one-twelfth part of the circumference. This deduction being made, is supposed to reduce the compass to that which the tree will have when the bark is stripped off.

Rule 4. From the given circumference, deduct the allowance for bark; and, with the remaining compass find the solidity by one of the foregoing rules.

Example. A tree is 40 feet long and 2 feet 8 inches quarter compass: required the solid contents, allowing 1-12th for bark.

1-12th of 2 feet 8 inches is 2 in. 8 pts.; then from 2 ft. 8 in. deducting 2 in. 8 pts. leaves 2 ft. 5 in. 4 pts. reduced quarter. Then 2 ft. 5 in. 4 pts. multiplied by 40 feet, is equal to 97 ft. 9 in. 4 pts. the solid content.

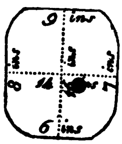
This is the class of timber usually bought by merchant-builders; and, to give some idea of the price, we annex the prices per foot given for the undermentioned trees, bought in the year 1803, and measured after each tree was felled and stript. The buyer had the lop, top, and bark, to defray the expences of felling and clearing; and the trees were measured as far as each would hold seven inches girt or twenty-eight inches circumference.

The following were the prices per foot, according to the respective meetings: 100 feet, 4*s.* 6*d.* per foot; 90 feet, 4*s.* 3*d.*; 80 feet, 4*s.*; 70 feet, 3*s.* 9*d.*; 60 feet, 3*s.* 6*d.* 50 feet, 3*s.* 3*d.*; 40 feet, 3*s.*; 30 feet, 2*s.* 9*d.*; and 20 feet, 2*s.* 6*d.*

The next class is the square or hewn timber, which is always squared by the merchants before it is served into the King's or other yards for the purpose of ship building. Hence the defects are more easily discovered, and proper abatements made in the price accordingly.

The contracts for the Navy say, that all timber must be squared in such a manner, that the sum of the breadth of the slabs taken off shall not be less than twice the sum of the wanes; if they are less, then the King's measurers cause the uppersides to be hewed until the dimensions are reduced to the terms above-mentioned; and, when the timber is measured, the sides of it, thus squared, are taken by a pair of callipers each way, and the two squares so taken are added together, the half of their sum gives a mean which, being multiplied by itself, and then into the length, produces the contents.

The last method of squaring rough timber, in order for measuring, is, that the four squares shall be equal to the two diameters, or more if possible, viz.



$$\text{Four squares}\left\{\begin{array}{r} \textit{In.} \\ 9 \\ 6 \\ 7 \\ 8 \\ \hline 30 \end{array}\right. \qquad \text{Both diameters}\left\}\begin{array}{r} \textit{In.} \\ 16 \\ 14 \\ \hline 30 \end{array}\right.$$

TO MEASURE AND COMPUTE THE SOLIDITY OF SQUARE TIMBER, AS RECEIVED INTO THE KING'S AND OTHER YARDS.

As, in consequence of the great irregularity in the growth of that timber which is most useful in ship-building, the taking a mean out of several girths or dimensions is not sufficiently accurate, the method that is used in the King's and other yards is, to measure the tree into as many lengths as the measurers shall judge proper; (that is, they mark off the different lengths as far as the tree regularly tapers;) and then find the contents of each length separately, and add the whole together; thus are the contents of the whole tree obtained, with branches or boughs measuring two feet compass, or six inches girt, which are reckoned as timber; their solidity being computed and added to that of the tree: but, so much of the trunk, boughs, or branches, as measure less than six inches, are not esteemed timber, and therefore not added to the other contents.

RULE 5. Measure the tree into as many lengths as may be judged necessary, then find the contents of each length as follows: when the lengths are set off, take the size of the tree upon the parts that are squared both ways; and exactly in the middle of each length; then add the two squares together; next take one half, which will give a mean square; multiply the mean square by itself, and the product by the respective length, the last product will be the contents: next add the contents of every length so found, and the total will be the solidity of the whole tree in feet; which, being divided by 50, the quotient will be the number of loads contained in the whole tree or number of trees.

NOTE 1. The mean square is a geometrical mean proportional between the mean breadth and thickness; that is, the square root of their product. Sometimes unskilful measurers use the arithmetical mean instead of it, that is half their sum; but this is always erroneous; and, the more so, as the breadth and depth differ the more from each other.

EXAMPLE. Required the solidity of a tree, whose dimensions are as follow: first length 18 feet; the square 16 inches by 18 inches; second length 12 feet; square 14 inches by 12 inches; third length 10 feet; square 10 inches by 8 inches; one branch, length 9 feet; square 8 inches by 6 inches; and another branch, length 8 feet; square 9 inches by 7 inches.

	ft. in.		ft. in.		ft. in.		ft. in.		ft. in.	
Mean Square	1 5	×	1 5	=	2 0 1	×	18 0	=	36 1 6	Contents of the 1st length.
	1 1	×	1 1	=	1 2 1	×	12 0	=	14 1 0	Second length.
	9	×	9	=	0 6 9	×	10 0	=	5 7 6	Third length.
	7	×	7	=	0 4 1	×	9 0	=	3 0 9	Of one branch.
	8	×	8	=	0 5 4	×	8 0	=	3 6 8	Of the other branch.

Solidity of the tree...62 5 5

The calculating of the dimensions by figures as above, shews the exact contents of the tree (according to the rule observed) to the twelfth part of an inch; but, as that would be so very tedious in measuring timber for sale, or in receiving it into store, the measurers, for quick dispatch, make use of the sliding rule; by which they calculate no nearer than to the half of a foot in the contents of each length; but that will be of little or no consequence; because the loss thereby will not be more than the odd inches in the above tree. After finding the contents of each length, by the sliding rule, they proceed as before, by adding them all into one sum for the contents of the whole.

TO FIND THE CONTENTS OF EACH LENGTH BY THE SLIDING RULE.

As 12 on the girt line, is to the *length* on the slider; so is the *mean square* on the girt line, to the *contents* on the slider.

TO MEASURE AND COMPUTE THE SOLIDITY OF THICKSTUFF AND PLANK, AS RECEIVED INTO THE KING'S AND OTHER YARDS.

RULE. Multiply the whole length of the plank by the breadth taken correctly in the middle, and the product will be the superficial contents; then, to find the solidity or number of loads contained therein, look for the thickness of plank or thickstuff, as given in a foregoing table, in this section, under which will be found the feet in a load, or divisor for dividing the superficial contents in feet, in order to give the solidity in loads.

EXAMPLE 1. Required, the number of loads contained in a piece of 10-inch thickstuff, the length of which is 49 feet, and the breadth, taken in the middle, 1 foot 9 inches.

49 feet × by 1 foot 9 inches is 85 feet 9 inches, which ÷ by 60 is 1 load 25 feet.

EXAMPLE 2. Suppose that there are ten planks of $2\frac{1}{2}$ inches thickness, each measuring 24 feet in length, and 13 inches broad in the middle, required the number of loads contained therein?

24 feet × by 1 foot 1 inch is 26 feet, which × by 10 is 260 feet superficial contents. Then 260 feet divided by 240 is equal to 1 load 20 feet, the solidity required.

BY THE SLIDING RULE.

As 12 on the slider is to the *breadth* on the rule, so is the *length* on the slider to the *contents* on the rule.

In the foregoing examples are contained all the cases that generally occur in the admeasuring of timber for sale; but, when timber is regularly and smoothly hewn, the solidities of such pieces had best be computed by the rules given for prisms, pyramids, cones, &c. and their frustums.

In converting timber in the forest, great care should be taken to preserve it as large and as circular as possible, from a consideration of the great use of large and compass timber; but it should be observed, at the same time, to adhere to the custom of squaring it by the rule before mentioned, as, if not so squared, the detriment would not only be in the false measure; but, the defects which might appear, were the timber truly squared, might remain unseen. And, as the defects in timber are of the utmost consequence, it should always be well examined when received or purchased, that the buyer may have an opportunity of having something abated in proportion to the nature of the defect. The defects in timber are various, but it is chiefly owing to the barrenness of the soil, as, in loose and broken ground, the timber is generally shaky, which is a very pernicious defect.

Lopping of timber, or the suffering of cattle to browse upon it, often occasions it to rot and decay. But the greatest enemies to the growth of young timber are rabbits; for, where there is a number of these animals, a spontaneous shoot can no sooner appear above the ground but it is destroyed. Sound timber is generally produced in those places where the earth consists of strong clay; for which reason, timber of English growth is found to be so far preferable to that of other countries; for, though some of the best sort of East-country plank is very flexible, and consequently useful for many purposes; yet it is often found very unserviceable, as it is, too frequently, either shaken, foxey, druxy, worm-eaten, or full of rotten knots; therefore, timber of English growth certainly has the preference, even after it has stood so long, that age has made it pliable and past the time allowed for growth, as it is even then allowed to be as durable as any other in its full strength.

TABLE OF SQUARES AND CUBES, WITH THE SQUARE ROOTS AND CUBE ROOTS.

Number.	Square.	Cube.	Square Root.	Cube Root.	Number.	Square.	Cube.	Square Root.	Cube Root.
1	1	1	1.0000000	1.000000	21	441	9261	4.5825757	2.758923
2	4	8	1.4142136	1.259921	22	484	10648	4.6904158	2.802039
3	9	27	1.7320508	1.442250	23	529	12167	4.7958315	2.843867
4	16	64	2.0000000	1.587401	24	576	13824	4.8989795	2.884499
5	25	125	2.2360680	1.709976	25	625	15625	5.0000000	2.924018
6	36	216	2.4494897	1.817121	26	676	17576	5.0990195	2.962496
7	49	343	2.6457513	1.912933	27	729	19683	5.1961524	3.000000
8	64	512	2.8284271	2.000000	28	784	21952	5.2915026	3.036589
9	81	729	3.0000000	2.080084	29	841	24389	5.3851648	3.072317
10	100	1000	3.1622777	2.154435	30	900	27000	5.4772256	3.107232
11	121	1331	3.3166258	2.223980	31	961	29791	5.5677644	3.141381
12	144	1728	3.4641016	2.289428	32	1024	32768	5.6568542	3.174802
13	169	2197	3.6055513	2.351335	33	1089	35937	5.7445626	3.207534
14	196	2744	3.7416574	2.410142	34	1156	39304	5.8309519	3.239612
15	225	3375	3.8729833	2.466212	35	1225	42875	5.9160798	3.271066
16	256	4096	4.0000000	2.519842	36	1296	46656	6.0000000	3.301927
17	289	4913	4.1231056	2.571282	37	1369	50653	6.0827625	3.332222
18	324	5832	4.2426407	2.620741	38	1444	54872	6.1644140	3.361975
19	361	6859	4.3588989	2.668402	39	1521	59319	6.2449980	3.391211
20	400	8000	4.4721360	2.714418	40	1600	64000	6.3245553	3.419952

TABLE OF SQUARES AND CUBES, WITH THE SQUARE ROOTS AND CUBE ROOTS.

Number.	Square.	Cube.	Square Root.	Cube Root.	Number.	Square.	Cube.	Square Root.	Cube Root.
41	1681	68921	6.4031242	3.448217	61	3721	226981	7.8102497	3.936497
42	1764	74088	6.4807407	3.476027	62	3844	238328	7.8740079	3.957892
43	1849	79507	6.5574385	3.503398	63	3969	250047	7.9372539	3.979057
44	1936	85184	6.6332496	3.530348	64	4096	262144	8.0000000	4.000000
45	2025	91125	6.7082039	3.556893	65	4225	274625	8.0622577	4.020726
46	2116	97336	6.7823300	3.583048	66	4356	287496	8.1240384	4.041240
47	2209	103823	6.8556546	3.608826	67	4489	300763	8.1853528	4.061548
48	2304	110592	6.9282032	3.634241	68	4624	314432	8.2462113	4.081656
49	2401	117649	7.0000000	3.659306	69	4761	328509	8.3066239	4.101566
50	2500	125000	7.0710678	3.684031	70	4900	343000	8.3666003	4.121285
51	2601	132651	7.1414284	3.708430	71	5041	357911	8.4261498	4.140818
52	2704	140608	7.2111026	3.732511	72	5184	373248	8.4852814	4.160168
53	2809	148877	7.2801099	3.756286	73	5329	389017	8.5440037	4.179339
54	2916	157464	7.3484692	3.779763	74	5476	405224	8.6023253	4.198336
55	3025	166375	7.4161985	3.802953	75	5625	421875	8.6602540	4.217163
56	3136	175616	7.4833148	3.825862	76	5776	438976	8.7177979	4.235824
57	3249	185193	7.5498344	3.848501	77	5929	456533	8.7749644	4.254321
58	3364	195112	7.6157731	3.870877	78	6084	474552	8.8317609	4.272659
59	3481	205379	7.6811457	3.892996	79	6241	493039	8.8881944	4.290841
60	3600	216000	7.7459667	3.914867	80	6400	512000	8.9442719	4.308870

TABLE OF SQUARES AND CUBES, WITH THE SQUARE ROOTS AND CUBE ROOTS.

Number	Square.	Cube.	Square Root.	Cube Root.	Number.	Square.	Cube.	Square Root.	Cube Root.
81	6561	531441	9.0000000	4.326749	101	10201	1030301	10.0498756	4.657010
82	6724	551368	9.0553851	4.344481	102	10404	1061208	10.0995049	4.672330
83	6889	571787	9.1104336	4.362071	103	10609	1092727	10.1488916	4.687548
84	7056	592704	9.1651514	4.379519	104	10816	1124864	10.1980390	4.702669
85	7225	614125	9.2195445	4.396830	105	11025	1157625	10.2469508	4.717694
86	7396	636056	9.2736185	4.414005	106	11236	1191016	10.2956301	4.732624
87	7569	658503	9.3273791	4.431047	107	11449	1225043	10.3440804	4.747459
88	7744	681472	9.3808315	4.447960	108	11664	1259712	10.3923048	4.762203
89	7921	704969	9.4339811	4.464745	109	11881	1295029	10.4403065	4.776856
90	8100	729000	9.4868330	4.481405	110	12100	1331000	10.4880885	4.791420
91	8281	753571	9.5393920	4.497942	111	12321	1367631	10.5356538	4.805896
92	8464	778688	9.5916630	4.514357	112	12544	1404928	10.5830052	4.820284
93	8649	804357	9.6436508	4.530655	113	12769	1442897	10.6301458	4.834588
94	8836	830584	9.6953597	4.546836	114	12996	1481544	10.6770783	4.848808
95	9025	857375	9.7467943	4.562903	115	13225	1520875	10.7238053	4.862944
96	9216	884736	9.7979590	4.578857	116	13456	1560896	10.7703296	4.876999
97	9409	912673	9.8488578	4.594701	117	13689	1601613	10.8166538	4.890973
98	9604	941192	9.8994949	4.610436	118	13924	1643032	10.8627805	4.904868
99	9801	970299	9.9498744	4.626065	119	14161	1685159	10.9087121	4.918685
100	10000	1000000	10.0000000	4.641589	120	14400	1728000	10.9544512	4.932424

TABLE OF SQUARES AND CUBES, WITH THE SQUARE ROOTS AND CUBE ROOTS.

Number.	Square.	Cube.	Square Root.	Cube Root.	Number.	Square.	Cube.	Square Root.	Cube Root.
121	14641	1771561	11.0000000	4.946088	141	19881	2803221	11.8743421	5.204828
122	14884	1815848	11.0453610	4.959675	142	20164	2863288	11.9163753	5.217103
123	15129	1860867	11.0905365	4.973190	143	20449	2924207	11.9582607	5.229321
124	15376	1906624	11.1355287	4.986631	144	20736	2985984	12.0000000	5.241482
125	15625	1953125	11.1803399	5.000000	145	21025	3048625	12.0415946	5.253588
126	15876	2000376	11.2249722	5.013298	146	21316	3112136	12.0830460	5.265637
127	16129	2048383	11.2694277	5.026526	147	21609	3176523	12.1243557	5.277632
128	16384	2097152	11.3137085	5.039684	148	21904	3241792	12.1655251	5.289572
129	16641	2146689	11.3578167	5.052774	149	22201	3307949	12.2065556	5.301459
130	16900	2197000	11.4017543	5.065797	150	22500	3375000	12.2474487	5.313293
131	17161	2248091	11.4455231	5.078753	151	22801	3442951	12.2882057	5.325074
132	17424	2299968	11.4891253	5.091643	152	23104	3511808	12.3288280	5.336803
133	17689	2352637	11.5325626	5.104469	153	23409	3581577	12.3693169	5.348481
134	17956	2406104	11.5758369	5.117230	154	23716	3652264	12.4096736	5.360108
135	18225	2460375	11.6189500	5.129928	155	24025	3723875	12.4498996	5.371685
136	18496	2515456	11.6619038	5.142563	156	24336	3796416	12.4899960	5.383213
137	18769	2571353	11.7046999	5.155137	157	24649	3869893	12.5299641	5.394690
138	19044	2628072	11.7473444	5.167649	158	24964	3944312	12.5698051	5.406120
139	19321	2685619	11.7898261	5.180101	159	25281	4019679	12.6095202	5.417501
140	19600	2744000	11.8321596	5.192494	160	25600	4096000	12.6491106	5.428835

TABLE OF SQUARES AND CUBES, WITH THE SQUARE ROOTS AND CUBE ROOTS.

Number.	Square.	Cube.	Square Root	Cube Root.	Number.	Square.	Cube.	Square Root.	Cube Root.
161	25921	4173281	12.6885775	5.440122	181	32761	5929741	13.4536240	5.656652
162	26244	4251528	12.7279221	5.451362	182	33124	6028568	13.4907376	5.667051
163	26569	4330747	12.7671453	5.462556	183	33489	6128487	13.5277493	5.677411
164	26896	4410944	12.8062485	5.473703	184	33856	6229504	13.5646600	5.687734
165	27225	4492125	12.8452326	5.484806	185	34225	6331625	13.6014705	5.698019
166	27556	4574296	12.8840987	5.495865	186	34596	6434856	13.6381817	5.708267
167	27889	4657463	12.9228480	5.506879	187	34969	6539203	13.6747943	5.718479
168	28224	4741632	12.9614814	5.517848	188	35344	6644672	13.7113092	5.728654
169	28561	4826809	13.0000000	5.528775	189	35721	6751269	13.7477271	5.738794
170	28900	4913000	13.0384048	5.539658	190	36100	6859000	13.7840488	5.748897
171	29241	5000211	13.0766968	5.550499	191	36481	6967871	13.8202750	5.758965
172	29584	5088448	13.1148770	5.561298	192	36864	7077888	13.8564065	5.768998
173	29929	5177717	13.1529464	5.572054	193	37429	7189057	13.8924440	5.778996
174	30276	5268024	13.1909060	5.582770	194	37636	7301384	13.9283883	5.788660
175	30625	5359375	13.2287566	5.593445	195	38025	7414875	13.9642400	5.798890
176	30976	5451776	13.2664992	5.604079	196	38416	7529536	14.0000000	5.808786
177	31329	5545233	13.3041347	5.614673	197	38809	7645373	14.0356688	5.818648
178	31684	5639752	13.3416641	5.625226	198	39204	7762392	14.0712473	5.828476
179	32041	5735339	13.3790882	5.635741	199	39601	7880599	14.1067360	5.838272
180	32400	5832000	13.4164079	5.646216	200	40000	8000000	14.1421356	5.848035

TABLE of the AREAS of the SEGMENTS of a CIRCLE, whose diameter is unity, and supposed to be divided into 1000 equal parts.

EXPLANATION. Each number in the column of *Area Seg.* is the area of the circular segment whose height, or the versed sine of its arc, is the number immediately on the left of it, in the column of *heights*; the diameter of the circle being one, and its whole area .785398. For the use and examples, see the last page.

Height.	Area Seg.	Height.	Area Seg.	Height.	Area Seg.	Height.	Area Seg.
.001	.000042	.037	.009383	.073	.025714	.109	.046381
.002	.000119	.038	.009763	.074	.026236	.110	.047005
.003	.000219	.039	.010148	.075	.026761	.111	.047632
.004	.000337	.040	.010537	.076	.027289	.112	.048262
.005	.000470	.041	.010931	.077	.027821	.113	.048894
.006	.000618	.042	.011330	.078	.028356	.114	.049528
.007	.000779	.043	.011734	.079	.028894	.115	.050165
.008	.000951	.044	.012142	.080	.029435	.116	.050804
.009	.001135	.045	.012554	.081	.029979	.117	.051446
.010	.001329	.046	.012971	.082	.030526	.118	.052090
.011	.001533	.047	.013392	.083	.031076	.119	.052736
.012	.001746	.048	.013818	.084	.031629	.120	.053385
.013	.001968	.049	.014247	.085	.032186	.121	.054036
.014	.002199	.050	.014681	.086	.032745	.122	.054689
.015	.002438	.051	.015119	.087	.033307	.123	.055345
.016	.002685	.052	.015561	.088	.033872	.124	.056003
.017	.002940	.053	.016007	.089	.034441	.125	.056663
.018	.003202	.054	.016457	.090	.035011	.126	.057326
.019	.003471	.055	.016911	.091	.035585	.127	.057991
.020	.003748	.056	.017369	.092	.036162	.128	.058658
.021	.004031	.057	.017831	.093	.036741	.129	.059327
.022	.004322	.058	.018296	.094	.037323	.130	.059999
.023	.004618	.059	.018766	.095	.037909	.131	.060672
.024	.004921	.060	.019239	.096	.038496	.132	.061348
.025	.005230	.061	.019716	.097	.039087	.133	.062026
.026	.005546	.062	.020196	.098	.039680	.134	.062707
.027	.005867	.063	.020680	.099	.040276	.135	.063389
.028	.006194	.064	.021168	.100	.040875	.136	.064074
.029	.006527	.065	.021659	.101	.041476	.137	.064760
.030	.006865	.066	.022154	.102	.042080	.138	.065449
.031	.007209	.067	.022652	.103	.042687	.139	.066140
.032	.007558	.068	.023154	.104	.043296	.140	.066833
.033	.007913	.069	.023659	.105	.043908	.141	.067528
.034	.008273	.070	.024168	.106	.044522	.142	.068225
.035	.008678	.071	.024680	.107	.045139	.143	.068924
.036	.009008	.072	.025195	.108	.045759	.144	.069625

Height.	Area Seg.	Height.	Area. Seg.	Height.	Area Seg.	Height	Area Seg.
.145	.070328	.192	.105472	.239	.144091	.286	.185425
.146	.071033	.193	.106261	.240	.144944	.287	.186329
.147	.071741	.194	.107051	.241	.145799	.288	.187234
.148	.072450	.195	.107842	.242	.146655	.289	.188140
.149	.073161	.196	.108636	.243	.147512	.290	.189047
.150	.073874	.197	.109430	.244	.148371	.291	.189955
.151	.074589	.198	.110226	.245	.149230	.292	.190864
.152	.075306	.199	.111024	.246	.150991	.293	.191775
.153	.076026	.200	.111823	.247	.150953	.294	.192684
.154	.076747	.201	.112624	.248	.151816	.295	.193596
.155	.077469	.202	.113426	.249	.152680	.296	.194509
.156	.078194	.203	.114230	.250	.153546	.297	.195422
.157	.078921	.204	.115035	.251	.154412	.298	.196337
.158	.079649	.205	.115842	.252	.155280	.299	.197252
.159	.080380	.206	.116650	.253	.156149	.300	.198168
.160	.081112	.207	.117460	.254	.157019	.301	.199085
.161	.081846	.208	.118271	.255	.157890	.302	.200003
.162	.082582	.209	.110083	.256	.158762	.303	.200922
.163	.083320	.210	.119897	.257	.159636	.304	.201841
.164	.084059	.211	.120712	.258	.160510	.305	.202761
.165	.084801	.212	.121529	.259	.161386	.306	.203683
.166	.085544	.213	.122347	.260	.162263	.307	.204605
.167	.086289	.214	.123167	.261	.163140	.308	.205527
.168	.087036	.215	.123988	.262	.164019	.309	.206451
.169	.087785	.216	.124810	.263	.164899	.310	.207376
.170	.088535	.217	.125634	.264	.165780	.311	.208301
.171	.089287	.218	.126459	.265	.166663	.312	.209227
.172	.090041	.219	.127285	.266	.167546	.313	.210154
.173	.090797	.220	.128113	.267	.168430	.314	.211082
.174	.091554	.221	.128942	.268	.169315	.315	.212011
.175	.092313	.222	.129773	.269	.170202	.316	.212940
.176	.093074	.223	.130605	.270	.171089	.317	.213871
.177	.093836	.224	.131438	.271	.171978	.318	.214802
.178	.094601	.225	.132272	.272	.172867	.319	.215733
.179	.095366	.226	.133108	.273	.173758	.320	.216666
.180	.096134	.227	.133945	.274	.174649	.321	.217599
.181	.096903	.228	.134784	.275	.175542	.322	.218533
.182	.097674	.229	.135624	.276	.176435	.323	.219468
.183	.008447	.230	.136465	.277	.177330	.324	.220404
.184	.099221	.231	.137307	.278	.178225	.325	.221340
.185	.099997	.232	.138150	.279	.179122	.326	.222277
.186	.100774	.233	.138995	.280	.180019	.327	.223215
.187	.101553	.234	.139841	.281	.180918	.328	.224154
.188	.102334	.235	.140688	.282	.181817	.329	.225093
.189	.103116	.236	.141537	.283	.182718	.330	.226033
.190	.103900	.237	.142387	.284	.183619	.331	.226974
.191	.104685	.238	.143238	.285	.184521	.332	.227915

Height.	Area Seg.	Height.	Area Seg.	Height.	Area Seg.	Height.	Area Seg.
.333	.228858	.375	.269013	.417	.310081	.459	.351745
.334	.229801	.376	.269982	.418	.311068	.460	.352742
.335	.230745	.377	.270951	.419	.312054	.461	.353739
.336	.231689	.378	.271920	.420	.313041	.462	.354736
.337	.232634	.379	.272890	.421	.314029	.463	.355732
.338	.233580	.380	.273861	.422	.315016	.464	.356730
.339	.234526	.381	.274832	.423	.316004	.465	.357727
.340	.235473	.382	.275803	.424	.316992	.466	.358725
.341	.236421	.383	.276775	.425	.317981	.467	.359723
.342	.237369	.384	.277748	.426	.318970	.468	.360721
.343	.238318	.385	.278721	.427	.319959	.469	.361719
.344	.239268	.386	.279694	.428	.320948	.470	.362717
.345	.240218	.387	.280668	.429	.321938	.471	.363715
.346	.241169	.388	.281642	.430	.322928	.472	.364713
.347	.242121	.389	.282617	.431	.323918	-473	.365712
.348	.243074	.390	.283592	.432	.324909	.474	.366710
.349	.244026	.391	.284568	.433	.325900	.475	.367709
.350	.244980	.392	.285544	.434	.326892	·476	.368708
.351	.245934	.393	.286521	.435	.327882	.477	.369707
.352	.246889	.394	.287498	.436	.328874	.478	.370706
.353	.247845	.395	.288476	.437	.329866	.479	.371705
.354	.248801	.396	.289453	.438	.330858	.480	.372704
.355	.249757	.397	.290432	.439	.331850	.481	.373703
.356	.250715	.398	.291411	.440	.332843	.482	.374702
.357	.251673	.399	.292300	.441	.333836	.483	.375702
.358	.252631	.400	.293369	.442	.334829	.484	.376702
.359	.253590	.401	.294349	.443	.335822	.485	.377701
.360	.254550	.402	.295330	.444	.336816	.486	.378701
.361	.255510	.403	.296311	.445	.337810	.487	.379700
.262	.256471	.404	.297292	.446	.338804	.488	.380700
.363	.257433	.405	.298273	.447	.339798	.489	.381699
.364	.258395	.406	.299255	.448	.340793	.490	.382699
.365	.259357	.407	.300238	.449	.341787	.491	.383699
.366	.260320	.408	.301220	.450	.342782	.492	.384699
.367	.261284	.409	·302203	.451	.343777	.493	.385699
.368	.262248	.410	.303187	.452	.344772	.494	.386699
.369	.263213	.411	.304171	.453	.345768	.495	387699
.370	.264178	.412	.305155	.454	.346764	.496	.388699
.371	.265144	.413	.306140	.455	.347759	.497	.389699
.372	.266111	.414	.307125	.456	.348755	.498	.390699
.373	.267078	.415	.308110	.457	.349752	.499	.391699
.374	.268045	.416	.309095	.458	.350748	.500	.392699

USE OF THE FOREGOING TABLE OF AREAS.

To find the area of the segment of a circle, whatever be the diameter, divide the height of the proposed segment by its own diameter, and the quotient will be a decimal to be sought in the column of heights, against which is the tabular area, similar to the proposed segment, that is to be taken out. This tabular area, multiplied by the square of the given diameter, will be the area of the segment required; similar areas being to each other as the squares of their diameters.

EXAMPLE. Required the area of a segment of a circle whose diameter is 50 and height of the segment 4?

50)4.00(0.08 the tabular height corresponding with .029435.

Therefore multiply .029435

By .... 2500 the square of the diameter.

Gives ...... 73.587500 the Product, or Area required.

If, in dividing the given height by the diameter, the quotient does not terminate in three places of decimals without a fractional remainder, then the area for that fractional part must be proportionally taken thus: having found the tabular area answering to the first three decimals of the quotient, take the difference between it and the next following tabular area, which difference is to be multiplied by the fractional remaining part of the quotient, and the product will be the corresponding proportional part to be added to the first tabular area.

Thus, if the given height of a segment be $4\frac{1}{3}$ or 4.3333, &c. to the diameter 50,

50)4.3333(0.086$\frac{1}{3}$

The number answering to .086 is .032745

The next area is.................. .033307

562

One third of which is 187

Added to first area .... .032745

.032932 Sum

Multiplied by .... 2500 Square of Diameter.

Gives............ 82.330000 the Area required.

AN

EXPLANATION OF THE TERMS

USED IN

SHIP BUILDING.

ABAFT. The hinder part of a ship, or toward the stern.

ABOARD. Within or upon a ship.

ABREAST. Alongside of, or opposite to; as in case of two or more ships lying with their sides parallel, and their heads equally advanced. With regard to objects within the ship, this term implies, on a line parallel with the beam, or at right angles with the ship's length.

AFLOAT. Borne up, or supported by, the water.

AFORE. The fore part of the ship, or towards the stem.

AFT. Towards, or near, the stern.

AFTER BODY. That part of the ship's body abaft the midships or dead-flat. (*See* BODIES. *See also* DEAD FLAT.) This term is, however, more particularly used in expressing the *figure* or *shape* of that part of the ship. (*See* BODY PLAN, *Plate I.*)

AFTER PART of the SHIP. All that part towards the stern from *Dead Flat.* Or, with regard to the relative position of things placed in the direction of the ship's length, the term *after* denotes that which is nearest the stern.

AFTER TIMBERS. All those timbers abaft the midships or bearing part of the ship.

AHEAD. Any thing which is situated before the ship, in a line with her length, is said to be *ahead* of her. Objects on board are said to be taken *ahead* when removed towards the stem.

AIR FUNNEL. A cavity framed in the openings of the timbers, to admit fresh air into the ship, and convey the foul air out of it. They are, generally, and should be, placed in the largest openings so as to be clear for passing the air freely. (*See Figure of the Air Funnel, on Plate I.*)

AMIDSHIPS. In midships, or in the middle of the ship, either with regard to her length or breadth. Hence that timber, or frame, which has the greatest breadth and capacity in the ship is denominated the *midship bend.* (*See* DEAD FLAT. *See also Sheer Draught, Plate I.*)

ANCHOR. The instrument of iron, &c. used by means of a cable, to confine the ship when riding thereby.

ANCHOR LINING. The short pieces of plank, or of board, fastened to the sides of the ship, or to stantions under the fore channel, to prevent the bill of the anchor from tearing the ship's side, when fishing or drawing up the anchor. (*See* Sheer Draught, *Plate I.*) It is only used in the navy, and many ships upon which it was fitted have lately had it taken away.

ANCHOR STOCK. Large cheeks of oak bolted and hooped together transversely to the upper end of the shank of the anchor.

To ANCHOR STOCK. To work planks in a manner resembling the stocks of anchors, by fashioning them in a tapering form, from the middle, and working or fixing them over each other, so that the broad or middle part of one plank shall be immediately above or below the butts or ends of two others. (*See Planking, Plate III.*) This method, as it occasions a greater consumption in the conversion, should only be used where particular strength is required, as in the spirkettings under the ports, &c.

AN-END. The position of any mast, &c. when erected perpendicularly on the deck. The top-masts are said to be *An-End* when they are hoisted up to their usual station. This is also a common phrase for expressing the driving of any thing in the direction of its length, as to force one plank, &c. to meet the butt of another.

ANGLE. (*See* Bevelling.)

APRON. A kind of false or inner stem, fayed on the aft side of the stem, from the head down to the dead-wood, in order to strengthen it. It is immediately above the foremost end of the keel, and conforms exactly to the shape of the stem, so that the convexity of one applied to the concavity of the other, forms one solid piece, which adds strength to the stem and more firmly connects it with the keel. (*See Inboard Works, Plate IV.*)

ARCH OF THE COVE. An elliptical moulding sprung over the cove at the lower part of the taffarel. (*See Perpendicular View of the Stern, Plate I.*)

ASTERN. Any distance abaft the ship, as opposed to *ahead.* Objects on board are said to be *astern* when nearer to the stern of the ship.

ATHWART. At right angles with the ship's length, or across the line of her course. Thus the stern frame stands *athwart* when exactly at right angles with the middle line of the ship's length.

AVAST! The command to stop or cease in any operation, as in bowsing, setting, &c.

BACK OF THE POST. The after-face of the stern-post.

BACK-STAYS. Ropes reaching from the topmast-heads to the after-part of each channel or to Stools called Backstay Stools, to support the topmasts, &c. and second the efforts of the shrouds when the mast is strained by a press of sail in a fresh wind. (*See* Steel's "*Art of Rigging.*")

BACKSTAY STOOL. A short piece of broad plank, bolted edgeways to the ship's side, at the after end of the channels, to project, and for the security of, the dead-eyes and chains for the *back-stays.* Sometimes the channels are left long enough to answer the purpose, as shewn in the *Sheer Draught, Plate I.* But this is an unnecessary waste of plank in the *main-channel.*

BACK-SWEEP. (*See* FRAMES.)

BADGE. A sort of ornament fixed on the quarters of small vessels near the stern, and containing, either a sash for the convenience of the cabin, or the representation of it. It is commonly decorated with carved work, as marine figures, martial instruments, &c.

BAG OF THE HEAD RAILS. The lowest part of the head-rails, or that part which partakes of the horizontal position. (*See Sheer Draught, Plate I.*)

BALCONY. The gallery in the stern of large ships. (*See Sheer Draught, and Perpendicular View of the Stern, Plate I.*)

BALANCE FRAMES. Those *frames*, or bends of timber, of an equal capacity, or area, which are equally distant from the centre of gravity. (*See* FRAMES.)

BALLAST. A quantity of iron, stone, gravel, or such like materials, deposited in a ship's hold, when she has no cargo, or too little to bring her sufficiently low in the water. It is used to counteract the effort of the wind upon the sails, and give the ship a proper stability, that she may be enabled to carry sail, without danger of oversetting. Some vessels are stiff enough from their construction to shift without ballast.

BALUSTERS. The ornamental pillars, placed along, or in front of, the balcony in the stern and quarters of large ships.

BARGE. (*See* BOATS.)

BARK. A name given to small ships, especially to *square-sterned* ships, having no head-rails, and to such as have three masts without a mizen top-sail.

BARREL. The main piece of a capstan or steering wheel. (*See* CAPSTAN and STEERING WHEEL. *See also those articles in the plan of the Inboard Works, Plate IV.*)

BARS OF THE CAPSTANS AND POST. (*See those Articles.*)

BASE. The foot or lowest part of a pillar; or that part of a body over which it rests, or is designed to rest.

BATTENS. In general, light scantlings of wood. In ship-building, long narrow laths of fir, whose ends are formed to correspond and fit into each other with mortise and tenon. They are used in setting fair the sheer-lines on a ship. In order to be the more conspicuous they are painted black. *Battens* used on the mould-loft floor for drawing lines, are narrow laths, of which some are accurately graduated and marked with feet, inches, and quarters, for setting-off distances. Battens for gratings are narrow thin laths of oak. (*See* GRATINGS.)

BEAK-HEAD. The short platform at the fore-part of the upper-deck, in large ships, placed at the height of the ports from the deck, for the convenience of the chase-guns. Its termination aft is the bulk-head called the *beak-head bulk-head*, which incloses the fore-part of the ship. (*See Sheer Draught, Plate I.*)

BEAK-HEAD BEAM. The same as CAT BEAM, which see under the article BEAMS.

BEAK-HEAD CARLINGS. Large carlings which are used to frame the beak-head instead of a *collar beam*.

BEAMS. The substantial pieces of timber, which stretch athwart the ship, from side to side, to support the decks and keep the ship together by means of the *knees*, &c. Their ends, being lodged on the *clamps*, keep the ship to her breadth. *(See Plan of the Deck, Plate IV.)*

A BEAM-ARM, or FORK-BEAM, is a curved piece of timber, nearly of the same depth as the beam, scarphed, tabled, and bolted, for additional security to the sides of the beams, athwart large openings in the decks, as the main hatchway and the mast-rooms. *(See Plan of the Deck, Plate III.)*

BREAST-BEAMS are the beams at the fore-part of the quarter-deck and round-house, and after part of the forecastle. They are sided larger than the rest; as they have an ornamental rail in the front, formed from the solid, and a rabbet one inch broader than its depth, which must be sufficient to bury the ends of the deals of the deck, with one inch above for a *spurn water*. To prevent splitting the beam in the rabbet, the nails of the deck should be crossed on each edge, or so driven alternately, as to form a zig-zag line.

THE CAT-BEAM, or BEAK-HEAD BEAM, is the broadest beam in the ship, generally made in two breadths, tabled and bolted together. The fore-side is placed far enough forward to receive the heads of the stantions of the beak-head bulk-head. *(See Inboard Works, Plate IV., and Half-breadth Plan, Plate I.)*

THE COLLAR BEAM is the beam upon which the stantions of the beak-head bulk-head stand. The upper side of it is kept well with the upper side of the upper deck port-sills, and lets down upon the spirketting at the side. But its casting over the bow-sprit, in the middle, giving it a form which in timber is not to be gotten without difficulty, a framing of two large carlings, and a stantion on each side of the bowsprit, is now generally substituted in its place. *(See Inboard Works, Plate IV.)*

HALF BEAMS are short beams introduced to support the deck where there is no framing; as in those places where the beams are kept asunder by hatchways, ladderways, &c. They are let down on the clamps at the side; and, near midships, into fore and aft carlings. On some decks, abaft the mizen mast, they are generally of fir, and let into the side tier of carlings. *(See Plan of the Deck, Plate III.)*

THE MIDSHIP BEAM is the longest beam of the ship, and lodged in the midship frame, or between the widest frame of timbers.

PALLETING BEAMS, are those beams under the flat of the magazine, bread-room, and powder-room, where there is a double *palleting*. Those of the upper tier are of fir, and rabbets taken out of their edges to form scuttles.

BEAM LINE. A line rated along the inside of the ship, fore and aft, shewing the uppersides of the beams at the side of the ship.

BEARDING. Diminishing the edge or surface of a piece of timber or plank, &c. from a given line, as on the *deadwood, clamps, plank-sheers, fife-rails*, &c. *(See Midship Sections, Plate III.)*

BEARDING LINE. A curved line occasioned by bearding or reducing the *deadwood* to the form of the ship's body. The *deadwood* being sided sufficiently, this line is carried high enough to prevent the heels of the timbers in the *cant-bodies* from running to a sharp edge, and forms a rabbet for the timbers to step on: hence it is often called the *Stepping Line*. *(See Sheer Draught, Plate I.)*

BED. A solid framing of timber, to receive and support the mortar in a *bomb vessel.*

BED or BARREL SCREWS. (*See* SCREWS.)

BEETLE. A large mallet, used by caulkers, for driving in their *reeming irons* to open the seams in order for CAULKING.

BELLFRY. An ornamental framing, made of stantions at the after beams of the forecastle, with a covering or top, under which the ship's bell is hung. In large ships the stantions are supported by knees. In small ships it is frequently built over the windlass.

BELL TOP. A term applied to the top of a quarter-gallery when the upper stool is hollowed away, or made like a rim, to give more height, as in the quarter galleries of small vessels, with the stool of the upper finishing coming home to the side, to complete overhead.

BELLY. The inside or hollow part of compass or curved timber, the outside of which is called the BACK.

BENCHES OF BOATS. The seats in the after part whereon the passengers sit.

BEND MOULD, in whole moulding. (*See* WHOLE MOULDING.) A mould made to form the futtocks in the square body, assisted by the RISING-SQUARE, and FLOOR-HOLLOW. (*See Long Boat, Plate IV.*)

BENDS. The frames or ribs that form the ship's body from the keel to the top of the side, at any particular station. They are first put together on the ground. That at the broadest part of the ship is denominated the MIDSHIP-BEND OR DEAD FLAT. (*See Midship Section, Plate III.*) In North Britain, the fore parts of the wales are commonly called *Bends.*

BETWEEN DECKS. The space contained between any two decks of a ship.

BEVEL. A well known instrument, composed of a stock and a moveable tongue, for taking the angles on wood, &c. which are, by shipwrights, called BEVELLINGS.

BEVELLING BOARD. A piece of deal on which the bevellings or angles of the timbers are described.

BEVELLINGS. The windings or angles of the timbers, &c.; a term applied to any deviation from a square or right angle. Of Bevellings there are two descriptions, denominated *Standing Bevellings* and *Under Bevellings.* By the former is meant an obtuse angle, or that which is *without a square* or right angle; and, by the latter, is understood, an acute angle, or that which is *within a square.* The BEVELLINGS of the TIMBER, are the angles which the moulding edges make with the joint.

BILGE. That part of a ship's floor, on either side of the keel, which has more of a horizontal than of a perpendicular direction, and on which the ship would rest if laid on the ground; or, more particularly, those projecting parts of the bottom which are opposite to the heads of the floor timbers amidships, on each side of the keel.

BILGE TREES, or BILGE PIECES, or BILGE KEELS. The pieces of timber, fastened under the bilge of boats or other vessels, to keep them upright when on shore, or to prevent their falling to *leeward* when sailing. BILGE KEELS thus constructed are recommended to strengthen that part of the ship. (*See Midship Section, Plate III.*)

BILGEWAYS. A square bed of timber, placed under the bilge of the ship, to support her while launching. The extreme distance of the bilgeways is generally one-third of the breadth of the ship; but this should be governed solely by the form of the midship bend.

BILL of the ANCHOR. The extremity of the arm.

BILLS. The ends of compass or KNEE TIMBER.

BINNACLE. (Formerly BITTACLE). A wooden case, or chest; which contains the compasses and the lights to shew them, by night, &c. It is divided into three compartments, with sliding shutters. Those at the side have a compass in each, and that in the middle is fitted to hold a lamp, or candles, which emit light on the compasses through a pane of glass on each side. In small vessels it is sometimes fixed before the companion, and the lights put in from the captain's ladderway, without going upon deck. On the deck of a ship of war there are always two binnacles, one for the use of the man who steers, and the other for him who *cons*, or superintends the steerage.

BINDING STRAKES. Two strakes of oak plank, worked all fore and aft upon each deck, and sometimes *scored* down between the beams three quarters of an inch. They are the second and third strakes from the coamings of the main hatchway, in order to strengthen the deck; as the strake next the hatchways, and the strakes between are cut off by the pumps, &c. (*See Upper Deck Plan, Plate IV.*)

BINDINGS. The iron links which surround the *Dead Eyes.* (*See Sheer Draught, Plate I., and Midship Section, Plate III.*)

BINS. A sort of large chests, or erections in *store-rooms*, in which the stores are deposited. They are generally 3 or 4 feet deep, and nearly of the same breadth, built with rabbeted deal, and have lids on the top.

TO BIRTH-UP. A term generally used for working up a topside or bulkhead with board or thin plank as the *counters*, &c.

BITTS. A frame of oak timber, whereon the cables or ropes are occasionally fastened. It consists of two upright pieces of oak, called *Bitt-pinns*, when the *bitts* are large, or of knees, when the *bitts* are small, with a *cross-piece* fastened horizontally athwartships near the head of them. The largest *Bitts* are commonly called the *Riding Bitts*, and are those to which the cables are fastened, when the ship rides at anchor. There are also small *Bitts* to belay ropes to, as the *Bow-line* and *Brace Bitts*, situated near the masts; the *Fore Jear* and *Topsail Sheet Bitts*, situated on the forecastle, and round the foremast; the *Main Jear* and *Topsail Sheet Bitts*, which tenon into the foremost beam of the quarter deck. The *Bitts* round the mizen mast are generally formed with knees, and have sheave-holes for the topsail sheets, &c. (*See Sheave-holes. See also Plans and Inboard Works, Plate III. and IV.*)

BITT-PINNS. The upright pieces of oak timber, let in and bolted to the beams of two decks at least, and to which the *Cross-pieces* are let on and bolted. (*See Inboard Works, Plate IV.*)

BLACK STRAKE. A broad strake, which is parallel to, and worked upon, the upper edge of the lower *wales*, in order to strengthen the ship. It derives its name from being paid with pitch, and is the boundary for the painting of the topsides. Ships having no ports near the *wales*, have generally two *black strakes.* (*See Planking and Midship Sections, Plate III.*)

BLOCK. The large piece of elm out of which the figure is carved at the head of the ship. (*See Sheer Draught, Plate I.*)

BLOCKS for building the ship upon, are those solid pieces of oak timber fixed under the ship's keel upon the groundways.

BLOCKS FIXED, are solid pieces of oak, let through the sides of the ship, and fitted with sheaves to lead the tacks, sheets, traces, &c. into the ship. The block to lead in the main-tack, is fixed at the after end of the fore channel, or before the *chestree*, and close up under the *sheer-strakes*. The *block* for leading in the *fore and spritsail sheets* is fixed in the side close up under the *sheer-strakes*, and just before the *fenders* or steps of the *gangway*. The *block* for leading in the *main-sheet* is fixed through the side, clear of the *wardroom* bulkhead, or just before it on the upper deck of large ships. In frigates and smaller ships it is fayed upon the plank-sheer, abreast of the mizen-mast. The block for the *main-brace* and studding sail sheet is fixed on the plank sheer close aft. The *blocks* for the main and fore lifts are *kevel-headed*, and are fixed either inside or out abreast their respective masts. The *blocks* for the *dorrick* and the *top and lift blocks*, are fixed outside, a little abaft the mizen-mast; the former on the starboard, and the latter on the larboard side.

BLOCKS to lead in the *catfall* are fixed on the *plank-sheer* over the *catheads*. A sheave-hole is cut in each, with a *snatch*, that the fall may lead in fair upon deck. The hole need not be cut through on the outside. (*See Sheer Draught, Plate I.*)

BLOCKS FOR TRANSPORTING the ship, are two solid pieces of elm or oak, one fixed on each side of the stem, above the taffarel, and a *snatch* with a large *score* cut each way in the middle. When used, the *hawser* is hauled in through the *snatch*.

BOARD. Timbers sawed to a less thickness than plank; all broad stuff of or under one inch and a half in thickness.

BOATS. Small vessels, either open or decked. Rowing boats are open, and others are generally decked over. Boats are managed on the water by rowing and sailing, and are occasionally slight or strong, sharp or flat bottomed, open or decked, plain or ornamented, as they may be designed either for celerity or burthen, for deep or shallow water, for sailing in a harbour or at sea, for convenience or pleasure.

The construction and the names of boats are different, according to the various purposes for which they are calculated, and the services required of them. The largest that ships take to sea is the LONG-BOAT, (*Plate IV.*), built very strongly, and furnished with masts and sails. The LAUNCH is a sort of LONG-BOAT, and is now generally taken to sea in its stead; but it is not built upon a principle of sailing, it being more flat, is broader, and more useful for weighing small anchors than the LONG-BOAT. The BARGE is next in size, but very different from the former in its construction, having a slighter frame, and being more ornamented. It is constructed for rowing or sailing, having conveniencies for ten or twelve oars, and two or three masts, and is chiefly used for the conveyance of admirals and other officers of rank to and from the ship. The PINNACE is of the same form as the barge, but is something smaller, and never rows more than eight oars. It is for smaller ships, or for the use of officers of subordinate rank. A YAWL is something less than the pinnace, nearly of the same form, and used for similar purposes. They are generally rowed with six oars. The above boats are all *carvel-built*. CUTTERS for ships are *clincher-built*, and are used for the conveyance of seamen, or the lighter stores. They are shorter and broader in proportion to their length than the long boat, and constructed either for rowing or sailing.

BOATSWAIN'S STORE ROOM. (*See* STORE ROOM.)

BOBSTAY. The large rope or stay used to confine the bowsprit upon the stem, and counteract the force of the stays which draw it upwards.

BOBSTAY HOLES. Holes cut through the fore part of the knee of the head, between the cheeks, large enough to admit the bobstay-collars, to which the bobstays are set up for the security of the bowsprit.

BODIES. The figure of a ship, &c. abstractedly considered, is supposed to be divided into different parts, or figures, to each of which is given the appellation of *body*. Hence we have the terms FORE-BODY, AFTER-BODY, CANT-BODIES, and SQUARE-BODY. Thus the *fore-body* is the figure, or imaginary figure, of that part of the ship afore the midships or dead-flat, as seen from ahead. The *after-body*, in like manner, is the figure of that part of the ship abaft the midships, or dead-flat, as seen from astern. The *cant-bodies* are distinguished into *fore* and *after*, and signify the figure of that part of a ship's body, or timber, as seen from either side, which form the shape forward and aft, and whose planes make obtuse angles with the midship line of the ship; those in the fore cant-body being inclined to the stem, as those in the after one are to the stern-post. The *square-body* comprehends all the timbers whose areas or planes are perpendicular to the keel, and square with the middle line of the ship; which is all that portion of a ship between the cant-bodies. (*See Sheer Draught, Plate I.*)

BOLLARD-TIMBERS, or KNIGHT-HEADS. (*See* KNIGHT HEADS.)

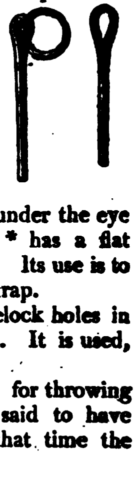
BOLSTERS. Pieces of oak timber, fayed to the curvature of the bow, under the *hawse-holes*, and down upon the upper cheek, or, solidly, between the cheeks, to prevent the *cable* from rubbing against the cheeks. (*See Sheer Draught, Plate I.*)

BOLSTERS for the ANCHOR LINING, solid pieces of oak, bolted to the ship's side, at the fore part of the fore chains, on which the stantions are fixed that receive the anchor lining. The fore end of the bolsters should extend about two feet before the lining, for the convenience of a man's standing to assist in *fishing* or raising the anchor. (*See Sheer Draught, Plate I.*)

BOLSTERS for sheets, tacks, &c. are small pieces of fir or oak, fayed under the *gunwale*, &c. with the outer surface rounded to prevent the *sheets* and other rigging from chafing.

BOLTS. Cylindrical or square pins, of iron or copper, of various forms, for fastening and securing the different parts of the ship, the guns, &c. The figure of those for fastening the timbers, planks, hooks, knees, crutches, and other articles of a similar nature, is cylindrical, and their sizes adapted to the respective objects which they are intended to secure. They have round, saucer, or collar heads, according to the purposes for which they may be intended; and the points are forelocked, or clinched on rings, to prevent their drawing. Those for bolting the frames or beams together are generally square.

RING and EYE BOLTS, for securing GUNS, &c. have the part that enters into the wood cylindrical. Those for ring-bolts have the rings turned into an eye made at the head of the bolt. The rings are sometimes made angular, to receive many turns of lashing; such are the bolts for lashing the booms and spare anchors. *Eye bolts* have only an eye made at the head of the bolt, to which the tackles, &c. may be hooked. *(See Midship Sections, Plate III.)* Some eye-bolts have a shoulder to them, to resist a great strain, as the fish-tackle eye-bolt, which has a plate, or long strap, made under the eye to prevent its burying into the plank. The TOGGLE-BOLT * has a flat head and a mortise through it, that receives a toggle or pin. Its use is to confine the ensign staff, &c. into its place, by means of a strap.



A WRAIN BOLT is a ring bolt, with two or more forelock holes in it, occasionally to belay or make fast towards the middle. It is used, with the wrain staff in the ring, for *setting-to* the planks.

BOMB-VESSEL. A vessel of war, particularly designed for throwing shells from mortars. It was invented by the French, and said to have been first used in the bombardment of Algiers. Prior to that time the throwing of shells from sea was supposed impossible.

BOMB-BED-BEAMS. The beams which support the bomb-bed in bomb-vessels.

BOOMKINS. *(See Bumkins.)*

BOTTOM. All that part of a ship or vessel that is below the wales. Hence we use the epithet *sharp-bottomed*, for vessels intended for quick-sailing; and *full-bottomed*, for such as are designed to carry large cargoes.

BOW. The circular part of the ship forward, terminated at the rabbet of the stem.

TO BOWSE. To pull upon any body with a tackle, &c. in order to remove it.

BOWSPRIT. The boom or mast projecting over the stem. *(See Sheer Draught, Plate I).*

BOXING. A projection of wood formerly left on the hawse-pieces, in wake of the hawse-holes, and which projected as far out as the plank inside and out. This method of fitting the hawse-holes is now, however, generally laid aside; as, among other advantages which attend the present practice, it is found that, as the method of boxing consumed an unnecessary quantity of large timber, this expence is now avoided: beside which, the planks, without boxing, run forward to the stem, and thereby strengthen the bow. The purpose of boxing is much better answered by a pipe of lead let through the holes, and turned with a flap inside and out, the undersides of which are the thickest, to allow for the wearing of the cable.

The term BOXING is also applied to the scarph of the lower piece of stem, let flatwise into the fore foot. *(See Sheer Draught, Plate I.)*

BRACES. Straps of iron, copper, or mixed metal, secured with bolts and screws to the stern-post and bottom planks. In the after ends are holes to receive the pintles by which the rudder is hung. *(See Sheer Draught, Plate I.)*

* The figure of this and other bolts may be seen in STEEL's "Art of Mast-making."

BRACES formerly called POINTERS, are also square pieces of timber fixed diagonally across the hold, to support the bilge and prevent the ship's working loose. (*See Midship's Section, Plate III.*) Braces were formerly fitted to extend from the bilge to the middle of the beam above.

BRACKETS. Short crooked timbers, resembling knees, for support or ornament. The HAIR-BRACKET is the boundary of the aft part of the figurehead, and its lower part finishes with the fore part of the upper deck. (*See Sheer Draught, Plate I.*) The CONSOLE BRACKET is a light piece of ornament, at the fore part of the quarter gallery, sometimes called a CANTING-LIVRE.

STERN-BRACKETS are carved ornaments on the munions, under the taffarel, at the arch of the cove, and sometimes under the balcony, &c.

BRAKES. The handles or levers by which the pumps are worked.

BREAD-ROOM. A place parted off below the lower deck, close abaft, for the reception of the bread. It should always be very completely covered with tin or other metal not so liable to corrode. (*See* STORE ROOMS.)

BREADTH. A term more particularly applied to some essential dimensions of the extent of a ship or vessel athawrtships, as the BREADTH-EXTREME, and the BREADTH-MOULDED, which are two of the principal dimensions given in the contract for building a ship. The *extreme-breadth* is the extent of the midships, or dead-flat, with the thickness of the bottom plank included. The *breadth-moulded*, is the same extent without the thickness of the plank.

BREADTH-LINE. A curved line of the ship lengthwise, intersecting the timbers at their greatest extent from the middle line of the ship. *See* (*Sheer Draught, Plate I.*)

BREADTH-SWEEPS. (*See Frames.*)

BREAK. The sudden termination or rise in the decks of some merchant ships, when the aft and sometimes the fore part of the deck is kept up to give more height between decks, as likewise at the *drifts*.

BREASTHOOKS. Large pieces of compass timber, fixed within and athwart the bows of the ship, of which they are the principal security, and through which they are well bolted. There is generally one between each deck, and three or four below the lower deck, fayed upon the plank. Those below are placed square to the shape of the ship at their respective places. The BREAST-HOOKS that receive the ends of the deck-planks are also called DECK-HOOKS, and are fayed close to the timbers in the direction of the decks. (*See Inboard Works, Plate IV., and Plans, Plates III. and IV.*)

BREAST-RAIL. The upper rail of the balcony, or of the *breast-work* at the fore part of the quarter deck. (*See Sheer Draught and Perpendicular view of the Stern, Plate I., Inboard Works, Plate IV., and Plan of the Deck, Plate III.*)

BREAST-WORK. The stantions, with their rails, at the fore part of the quarter-deck. The breast-work fitted on the upper deck of such ships as have no quarter-deck serves to make a separation from the main-deck. (*See Inboard Works, Plate IV., and Plan of the upper Deck, Plate III.*)

BREECH. The angular part of knee-timber.

BRIG or BRIGANTINE. A merchant vessel, having two masts, with the mainsail fore and aft, and not athwartships as in ships. In the Royal Navy, when cutter-built vessels are thus rigged, they are called CUTTER-BRIGS.

BROKEN-BACKED or HOGGED. The condition of a ship when the sheer has departed from that regular and pleasing curve with which it was originally built. This is often occasioned by the improper situation of the *centre of gravity*, when so posited as not to counterbalance the effort of the water in sustaining the ship, or by a great strain, or from the weakness of construction. The latter is the most common circumstance, particularly in some French ships, owing partly to their great length, sharpness of floor, or general want of strength in the junction of the component parts. (*See* HOGGING.)

BUCKLERS. Pieces of elm plank barred close against the inside of the *hawse-holes*, to a *cant below*, and under the hook above, to prevent the water from coming in. Those used at sea, denominated BLIND-BUCKLERS, have no aperture; but those used in a harbour, &c. when a ship is at anchor, and called RIDING-BUCKLERS, are made in two pieces, the upper piece rabbeting on the lower piece at the middle of the hawse-hole, and the two pieces, when joining, have a hole in the middle, large enough to admit the cable.

BULGE or BILGE. That part of the ship which she bears on most when not afloat. It may be readily known by drawing a line from the underside of the keel to touch the body. (*See* BILGE.)

BULGEWAYS. (*See* BILGEWAYS.)

BULKHEADS. The various partitions which separate one part of a ship from another. Those in the hold are mostly built with rabbetted or cyphered plank, as are those of the magazine, to keep the powder securely from the cargo, ballast, or stowage in the hold. Thus likewise are the fish and bread-room bulkheads. Those upon the decks are mostly to separate the officers from the seamen; as the ward-room bulkhead, which is composed of doors and panels of joiner's work. Thus, also, the cabin and screen bulkheads, in large ships, inclose the cabin from the walk abaft, or balcony: and, forward, the gallery is inclosed by the beak-head bulk-head.

BUM-KIN, or more properly BOOM-KIN. A projecting piece of oak or fir, on each bow of a ship, fayed down upon the false-rail, or upper rail of the head, with its heel cleated against the knight-head in large, and the bow in small ships. It is secured, outwards, by an iron strap, and rod or rope lashing, which confine it downwards to the knee or bow. It is used for the purpose of hauling down the fore-tack of the fore-sail.

BURTHEN. The weight or measure that any ship will carry or contain when fit for sea. (*See* TONNAGE.)

BUSHED. Cased with harder metal, as that inserted into the holes of braces or sheaves to prevent their wearing, and, consequently, to take off friction.

BUTT. The joints of the planks endwise, also the opening between the ends of the planks when worked for caulking. Where caulking is not used, the butts are sometimes rabbetted, and must fay close. Hence the former are called caulking-butts, and the latter close-butts. (*See Planking*,

Plate III., and Plans, Plate III.) Butt also signifies the root or biggest end of all timbers, plank, &c.

BUTTOCK. That rounding part of the body abaft, bounded by the fashion-pieces; and, at the upper part, by the wing-transom.

BUTTOCK LINES. (On the Sheer Draught). Curves, lengthwise, representing the form of the ship's body cut in vertical section. *(See Buttock Lines further explained in the Directions for constructing the* Sheer Draught. *See also Sheer Draught, Plate I.)*

CABINS. The apartments partitioned off, in several parts of the ship, for the residence of the officers, of which the principal is for the commander. *(See Plans, Plate III. and IV.)*

CABLE. A rope, more than nine inches in circumference, and generally one hundred fathoms in length, used to retain the ship at anchor.

CABLE TIER. The space occupied by the cables on the flop-deck.

CALLIPERS. Compasses with circular legs, for taking correctly the diameter or size of the timber. There is a smaller sort for taking the diameter of bolts or any thing cylindrical.

CALVES TONGUE. (*See* Tongue.)

CAMBER. Arching upwards. The decks are said to be *cambered* when their height increases toward the middle from stem and stern, in the direction of the ship's length.

CANT. A term signifying the inclination that any thing has from a square or perpendicular. Hence the shipwrights say,

CANT BODY, meaning that part of a ship's body or timbers which form the shape of the body forward and aft, and whose planes make obtuse angles with the midship line of the ship, those in the fore body inclining to the stem, as those in the after body incline to the stern-post. *(See* Bodies. *See also Sheer Draught, Plate I.)*

CANT RIBBANDS, are those ribbands that do not lie in a horizontal or level direction, or square from the middle line, but nearly square from the timbers, as the diagonal ribbands. *(See* Ribbands. *See also Sheer Draught, Plate I.)*

CANT TIMBERS, are those timbers afore and abaft, whose planes are not square with, or perpendicular to, the middle line of the ship. *Yet their planes are square with or perpendicular to the keel.* *(See* Cant-timber *u* upon the Sheer Draught, Plate I.)

CANTING. The act of turning any thing completely over, so that the under surface shall lie upwards. It is otherwise said to be *half or quarter canted.*

CANTING LIVRE. The same as *console bracket.* *(See* Brackets.)

CAPS. Square pieces of oak, laid upon the upper blocks on which the ship is built, to receive the keel. They should be the most free grained oak, that they may be easily split out when the false keel is to be fixed in its place. The depth of them may be a few inches more than the thickness of the false keel, that it may be set up close to the main keel by slices, &c.

A CAP SCUTTLE. A framing composed of coamings and head ledges, raised above the deck, with a top which shuts closely over into a rabbet. *(See Inboard Works, Plate I.)*

CAPSTAN. The machine formed of a massy column of timber, &c.

and used for heaving up the anchor, or other purposes which require an extraordinary effort. It is composed, as *described hereafter*, of several pieces, strongly united into one body, called the *Barrel*, and put in motion by the levers named *Capstan Bars*, which fit into mortise holes in its head. Ships having a windlass, the capstan generally traverses on an iron *spindle*. (*See Capstan Inboard Works, Plate IV.*)

CAPTAIN'S STORE ROOM. (*See* STORE ROOMS.)

CARLINGS. Pieces of timber, above four inches square, which lie fore and aft, in tiers, from beam to beam, into which their ends are scored. They receive the ends of the *ledges* for framing the decks. The carlings by the side, and for the support of the masts, which receive the framing round the mast called the *partners* are much larger than the rest, and are named the MAST CARLINGS. Besides these there are others, as the PUMP CARLINGS, which go next without the MAST CARLINGS, and between which the pumps pass into the well. (*See Plans, Plate III. and IV.*) Also the Fire-hearth Carling, that lets up under the beams on which the fire-hearth stands, with pillars underneath, and chocks upon it, fayed up to the ledges for support. (*See Inboard Works, Plate IV.*)

CARPENTER'S STORE ROOM. (*See* STORE ROOMS.)

CARRICK BITTS. The upright pieces of timber, near the ends of the windlass, in which are the gudgeons for the *spindles* to work on. (*See Windlass, Plate III. and IV.*)

CARVEL WORK. A term applied to cutters and boats, signifying that the seams of the bottom planking are square, and to be kept tight by caulking as those of ships. It is opposed to the phrase CLINCHER-BUILT, which see.

TO CAST. To stretch over any thing, as

CAST-KNEES, or those hanging-knees which croak or arch over the corner of a gun-port, rider, &c.

CAT-BEAM. (*See* BEAM.)

CAT-BLOCK. (*See* BLOCKS.)

CAT-HEADS. The strong arms of oak, projecting from each side of the ship, at the fore part of the forecastle with sheaves in the outer end, for the purpose of hoisting the anchor. (*See Sheer Draught, Plate I.*)

CATS-TAIL. The inner part of the cathead, that fays down upon the cat beam, in large ships, and under the forecastle beams of smaller ships.

CAVITY. The hollow formed in the water by an immersed body. (*See* CENTRE OF CAVITY.)

CAULKING. Forcing oakum into the seams, and between the butts of the plank, &c. with iron instruments, in order to prevent the water penetrating into the ship.

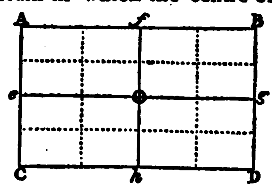
CEILING or FOOTWALING. The inside planks of the bottom of the ship.

CENTRE OF CAVITY, or of DISPLACEMENT. The centre of that part of the ship's body which is immersed in the water; and which is also the centre of vertical force that the water exerts to support the vessel.

CENTRE OF GRAVITY. That point about which all the parts of the body do, in any situation, exactly balance each other. Hence, 1. If a body be suspended by this point as the centre of motion, it will remain at rest in any position indifferently, 2. If a body be suspended in any other point, it can rest only in two positions, viz. when the centre of gravity is exactly above or below the point of suspension. 3. When the centre of gravity is supported, the whole body is kept from falling. 4. Because this point has a constant endeavour to descend to the centre of the earth, therefore, 5. When the point is at liberty to descend, the whole body must also descend, either by sliding, rolling, or tumbling over.

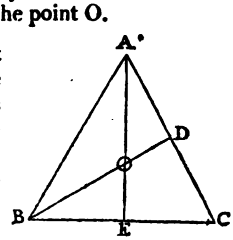
It follows, that the centre of gravity of a line or beam, as A B, is in the middle of its length; so that, if supported by a fulcrum in the centre, it would hang in equilibrio, as a balance, and the point of support will be the axis of the equilibrium: and if in this situation, a weight, equally distributed, as at A and B, were laid upon it, the balance would still be the same. By supposing a plane to cross the beam in the point of support, we shall have an idea of the plane of the equilibrium; that is to say, of a plane in which the centre of gravity is to be found.

Upon the same principle, it may be readily shewn, that the centre of a parallelogram is at O: for, supposing the parallelogram to be formed by elementary lines parallel to A B, as $e\ g$, the middle point of each will describe the line $f\ h$, the axis of the equilibrium in which the centre of gravity of the whole figure must certainly be found. Let us then suppose other elementary lines, parallel to BD, and we shall then have another axis of the equilibrium, in which, likewise, the centre of gravity must be; and, because the point O is the only one common to both axes, it must be the centre of gravity: hence the centre of gravity of a parallelogram must be in the centre of the figure. For the same reasons, the centre of gravity of the circles, ellipses, and polygons, of any even number of sides, will be in the centre of their respective figures.

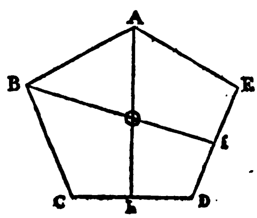


Again, if we suppose, as shewn in the foregoing figure, an assemblage of similar parallelograms, the centre of gravity, or momenta of the whole, collectively, will of course, be found in the point O.

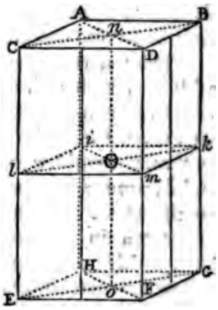
From what has been said it will be clear, that the centre of gravity of any triangle may be readily found; for, if we bisect any two sides by lines continued to the opposite angle, as the sides A C or A B by the lines D B and A E, the point of intersection O will be the centre of gravity of the triangle.



Again, in the regular pentagon ABCDE, we shall have the axis A h and the axis Bf; so shall O, the intersection of the two axes, be the centre of gravity of the pentagon.



As, by the foregoing simple methods we may find the centres of gravity of regular surfaces; so, if we consider surfaces as the elements of solids, we may as easily find the centres of gravity of solids. For, if we conceive the parallelopiped, represented in the margin, to be formed by an infinite number of parallelograms, parallel to A B C D, the centre of gravity of all the parallelograms will be in the centre of each figure, as before shewn; and, if we draw a line, *n o*, through all the centres of gravity, we shall have the axis of the equilibrium in which the centre of gravity of the parallelopiped is to be found. Now, as all the parallelograms are equal, we may conclude that the centre of gravity of the parallelopiped is in the middle of the axis *n o*, at O. For the same reason, the centres of gravity of a cylinder, of a sphere, or of an ellipsoid will be found exactly in the centre of these solids.



As any prism may be considered as composed of surfaces, or thin slices, equal and similar to the area of its bases, a straight line drawn from the centre of one base to that of its opposite, will pass through all the elementary slices; and, therefore, the centre of gravity of all prisms, or cylinders, will be in the middle of that line, which is the axis of the equilibrium.

With respect to a triangular pyramid, it is obvious, that its centre of gravity will be found in a straight line drawn from the vertex to the centre of the base. For, supposing the pyramid to be divided into elementary slices, parallel to the base, the centres of gravity of all these surfaces will be similarly placed; and, using the same operation on all sides of the pyramid, we shall obtain the axes of the equilibrium, whose point of intersection, at one-fourth of the length from the base, will be the centre of gravity. A cone, as we have already shewn, may be considered as a pyramid, having an infinite number of sides, and its centre of gravity will consequently be found also at one fourth of its axis from the base.

The centre of gravity of a ship, although a very irregular body, may be very nearly found by an application of the principles which we have here explained; namely, by finding the areas and momenta of different horizontal and perpendicular sections, each of which is supposed to be divided into figures so nearly regular, that their differences shall be of little or no consequence in practice.

CENTRE OF MOTION. That point of a body which remains at rest whilst all the other parts are in motion about it; and this is the same, in bodies of one uniform density throughout, as the centre of gravity.

CHAIN or CHAINS. The links of iron which are connected to the binding that surround the dead-eyes of the channels. They are secured to the ship's side by a bolt through the *toe-link*, called a *chain-bolt*. (*See Sheer Draught, Plate I., and Midship Section, Plate III.*)

CHAIN-BOLT. A large bolt to secure the chains of the dead-eyes, for the purpose of securing the mast by the shrouds. (*See Sheer Draught, Plate I., and Midship Section, Plate III.*)

CHAIN-PLATES. Thick iron plates, sometimes used in merchant ships, which are bolted to the ship's sides, instead of chains to the dead-eyes, as above.

CHAMFERING. Taking off the sharp edges from timber or plank, or cutting the edge or end of any thing bevel or aslope.

CHANNELS. The broad projection or assemblage of planks, fayed and bolted to the ship's sides, for the purpose of spreading the shrouds with a greater angle to the dead-eyes. They should therefore be placed either above or below the upper deck ports, as may be most convenient, But, it is to be observed, that, if placed too high, they strain the sides too much; and, if placed too low, the shrouds cannot be made to clear the ports without difficulty. Their disposition will therefore depend on that particular which will produce the greatest advantage. They should fay to the sides only where the bolts come through, having an open space of about two inches in the rest of their length, to admit a free current of air, and a passage for wet and dirt, in order to prevent the sides from rotting. *(See Sheer Draught, Plate I., and Midship Section, Plate III.)*

CHANNEL WALES. Three or four thick strakes, worked between the upper and lower deck ports in two-decked ships, and between the upper and middle deck ports in three-decked ships, for the purpose of strengthening the top-side. They should be placed in the best manner for receiving the chain and preventer bolts, the fastenings of the deck-knees, &c. *(See Sheer Draught, Plate I.)*

CHASE. A score cut lengthwise for a tenon to be fixed in, as the tenon at the heels of pillars, &c. Ledges may be *chased-about* into the carlings, or the carlings into the beams, by cutting the score or chase large enough at one end for it to sweep about into its place.

CHASE PORTS. The ports at the bows, and through the stern of the ship. The former are made for the purpose of firing at an enemy a-head, and are called bow-chasers. The latter for the purpose of firing upon an enemy in pursuit, or for dismasting an enemy that may lie athwart the stern, in order to rake the ship.

CHEEKS. Knees of oak timber which support the knee of the head, and which they also ornament by their shape and mouldings. They form the basis of the head, and connect the whole to the bows, through which and the knee they are bolted. *(See Sheer Draught, Plate I.)*

CHEEKS are also the circular pieces on the aftside of the carrick bitts. *(See Windlass, in Plate IV.)*

CHESTREES. Pieces of oak timber, fayed and bolted to the top-sides, one on each side, abaft the fore-channels, with a sheave fitted in the upper part for the convenience of hauling home the main-tack. Its true situation is half the length of the main-yard before the centre of the main-mast. *(See Sheer Draught, Plate I.)*

CHINE. That part of the waterways which is left the thickest, and above the deck plank. It is bearded back that the lower seam of spirketting may be more conveniently caulked, and is gouged hollow in front to form a watercourse. *(See Midship Section, Plate III.)*

TO CHINSE. To caulk slightly, with a knife or chisel, those seams or openings that will not bear the force required for caulking in a more proper manner.

CHISELS. Edged tools, too well known to require a particular description, and in cutting away wood, &c.

COLD CHISELS are short stout chisels made of steel, for cutting iron bolts, &c.

CHOCKS. Smaller pieces of wood used to make good some deficiency in the main-piece, as those at the heads and heels of timbers, to fashion out knees, &c. *(See Plans, Plates III. and IV., and Midship Section, Plate III.)*

CROSS-CHOCKS are larger pieces of oak timber, fayed across the dead-wood and heels of the first-futtocks, to make them equal in height with the floor. In merchant ships they are seldom used. Elm for this purpose may be used with the same advantage as oak, as along the midships it will be equally durable, and is less liable to split. *(See Midship Section, Plate III.)*

CHOCKS or ROWLOCK CHOCKS OF BOATS, are a sort of cleat, fastened on the gunwale to support the sholes. WINDLASS CHOCKS are fastened inside the bows of small craft, to support the ends of the windlass.

CLAMPS. Those substantial strakes worked within side the ship, upon which the ends of the beams are placed. *(See Midship Section, Plate III.)*

CLAMPS, HANGING. *(See* HANGING CLAMPS.)

CLEAN. A term generally used to express the acuteness or sharpness of a ship's body; as when a ship is formed very acute or sharp forward, and the same aft, she is said to be *clean* both forward and aft.

CLEATS. Pieces of wood, of various shapes, according to their uses, either to resist or support great weight; as Fig. I, on Plate III, called a *Wale-cleat;* and Figs. II and III. *Shore-cleats,* and Fig. IV. a *Tapered-cleat,* bolted under beams, to support them where pillars are not used.

CLINCHER-BUILT. A term applied to the construction of some vessels and boats, when the planks of the bottom are so disposed, that the lower edge of every plank overlays the next under it, and the fastenings go through and clinch or turn upon the timbers. It is opposed to the term CARVEL WORK.

CLINCHING or CLENCHING. Spreading the point of a bolt upon a ring, &c. by beating it with a hammer, in order to prevent its drawing.

CLOSE-QUARTERS. Strong barriers, or bulkheads, stretching athwart a merchant ship, in several places, and behind which the crew may retreat when boarded by an enemy. They are therefore fitted with several loop-holes, through which the small arms may be fired, with other conveniencies for the defence of the ship, and the annoyance of the adversary.

COACH or COUCH. An apartment before the captain's cabin.

COAMING CARLINGS. Those carlings that inclose the bomb-beds of bomb-vessels, and which are called carlings because they are shifted occasionally.

COAMINGS. The raised borders of oak about the edge of the hatches and scuttles, which prevent water from flowing down from off the deck. Their inside upper edge has a rabbet to receive the gratings. *(See Inboard Works, Plate IV., and Plans, Plates III. and IV.)*

COAT. A covering of paint, or other materials, by which the ship's sides, &c. are defended from the weather. Hence we say, "Give her a good coat of paint, pitch," &c.

COBOOSE. A small shifting kind of shed or galley, to cover the fire place of some merchant ships. It generally stands against the barricade on the fore-part of the quarter-deck, or shifts occasionally.

COCK PIT. That part of the after platform, under the lower deck, between the store-rooms, where the wounded are taken down to be dressed in time of action, and where the surgeon has a repository for his medicines, &c.

COLLAR BEAM. *(See* BEAMS.)

TO COME UP. To cast loose the forelocks or lashings of a sett, in order to take in closer to the plank.

COMPANION. In ships of war, the framing and sash lights upon the quarter-deck or round-house, through which the light passes to the commander's apartments; and, from the upper deck to the gun or mess-room in frigates. In merchant ships it is the birthing or hord round the ladder-way, leading to the master's cabin, and in small ships is chiefly for the purpose of keeping the sea from beating down. *(See Inboard Works, Plate IV. and Plan, Plate III.)*

COMPASS TIMBER. Any timber that is curved in its shape.

COMPASSING. Crooked or curved.

CONVERSION. The art of lining and moulding timber, plank, &c. with the least possible waste, and one that the student can never make himself too well acquainted with.

COPING. Turning the ends of iron lodging knees so that they may hook into the beams.

COUNTER. A part of the stern; the *lower counter* being that arched part of the stern immediately above the wing transom. Above the lower counter is the *second counter*, the upper part of which is the under part of the lights or windows. The counters are parted by their rails, as the lower counter springs from the tuck-rail, and is terminated on the upper part by the lower counter-rail. From the upper part of the latter, springs the upper or second counter, its upper part terminating in the upper counter rail, which is immediately under the lights. *(See Sheer Draught and Perpendicular View of the Stern, Plate I.)*

COUNTER MOULD. The converse of the mould. *(See* MOULDING.) If, when a piece of timber, moulded on both sides, as the keelson, breast-hooks, riders, &c. is intended to fay at once, the operation is performed thus: after one edge is accurately trimmed to the mould, the windings or bevellings are taken square from the piece, and accurately applied to the part to which it is to be fayed, and one or sometimes three square spots set off on the counter-side. Then the counter-mould, after being exactly fayed, and the square spots marked, is laid on the piece, to answer the corresponding square spots there; and, they agreeing, the piece may be trimmed through to the first moulding edge, and will not fail to answer. If there should be wanes on the piece, the mould had better be tacked fast to the side of the piece, and the edge of the mould taken square in; and, to be the more exact, the rase, or the wood to the edge of the mould, had better be taken away with a chisel, and dubbed through afterwards.

COUNTER RAILS. The ornamented rails athwart the stern, into which the counters finish. *(See Sheer Draught and Perpendicular View of the Stern, Plate I.)*

COUNTER SUNK. The hollow in iron-plates, &c. which are excavated by an instrument called a counter sunk bitt, to receive the heads of screws or nails, so that they may be flush or even with the surface.

COUNTER TIMBERS. The right-aft timbers which form the stern. The longest run up and form the lights, while the shorter run up only to the under part of them, and help to strengthen the counter. The side counter timbers are mostly formed of two pieces, scarphed together in consequence of their peculiar shape, as they not only form the right-aft figure of the stern, but partake of the shape of the top-side also. Sometimes those right-aft are made in two. *(See Sheer Draught, and Perpendicular View of the Stern, Plate I.)*

COVE. The arched moulding sunk in at the foot or lower part of the taffarel. *(See Sheer Draught, and Perpendicular View of the Stern, Plate I.)*

CRAB. A smaller sort of capstan, formed of a wooden pillar, and three or more small whelps, whose lower end works in a socket, whilst the middle traverses or turns round in partners which clip it in a circle. Above the whelps are two holes to receive bars, that act as levers, and by which it is turned round. It serves as a capstan for raising of weights, &c.

By a machine of this kind, so simple in its construction, may be heaved up the frame timbers, &c. of vessels when building. For this purpose it is placed between two floor timbers, while the partners which clip it in the middle may be of four or five inch plank fastened on the same floors. A block is fastened beneath in the slip, with a central hole for its lower end to work in, *as Fig. 5. on Plate III.*

Besides the crab described here, there is another sort which is shorter and portable. The latter is fitted in a frame composed of cheeks, across which are the partners, and at the bottom a small platform to receive the spindle, as *Fig. 6, Plate III.*

CRADLE. A strong frame of timber, &c. placed under the bottom of a ship in order to conduct her steadily in her *ways* till she is safely launched into water sufficient to float her. *(See Frontispiece.)*

CRANK. A term applied to ships built too deep in proportion to their breadth, and from which they are in danger of oversetting.

CRANKS. Pieces of iron, shaped as an elbow, &c. and attached to the beams of the quarter-deck for the capstan bars to be stowed thereon; they are sometimes fitted to stow the bars under the boatskids. Others are driven in the upper part of the taffarel, to support the stern lanterns.

CROAKY. A term applied to plank when it curves or compasses much in short lengths.

CROSS-BORED. Bored with holes alternately on the edges of planks, &c. to separate the fastenings, so as to avoid splitting the timbers or beams.

CROSS-CHOCKS. *(See* CHOCKS.)

CROSS PIECES. The pieces of timber bolted athwart ships to the bitt-pins, for taking turns with the cable, or belaying ropes to. Also a rack, with belaying pins through it, extending from the carrick-bitts over the windlass of a merchant ship.

CROSS-SPALES. Deals, or fir plank, nailed in a temporary manner to the frames of the ship at a certain height, and by which the frames are kept to their proper breadths, until the deck-knees are fastened. The main and top-timber breadths are the heights mostly taken for spaling the frames, but the height of the ports is much better; yet this may be thought too high if the ship is long in building, or the ground not to be depended upon.

CROW. An iron lever, used to prize about the timbers, or any weight, particularly when in such a situation as not to be handled. Crows are of various sorts; some are opened at the end, with a claw for drawing nails, others have a moveable staple at the end for drawing small bolts or large nails. The latter are commonly called *Engine Crows.*

CROW-FOOT. The same as BEAM-ARM. *(See* BEAM-ARM.)

CRUTCHES or CLUTCHES. The crooked timbers fayed and bolted upon the foot-waling abaft, for the security of the heels of the half-timbers. *(See Inboard Works, Plate IV.)* Also stantions of iron or wood, whose upper parts are forked to receive rails, spare masts, yards, &c. and which are fixed along the sides and gangways.

CUDDY. The cabin abaft, under the round house of East India ships, for the captain's apartment.

CUP. A solid piece of cast iron, let into the step of the capstan, and in which the iron spindle works which is at the heel of the capstan.

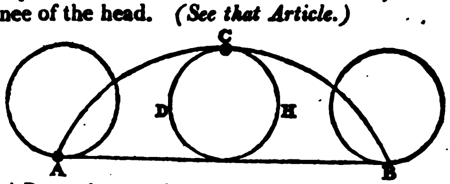
CUTTER. A swift sailing vessel with one mast, more particularly described hereafter.

CUTTER-BRIG. *(See* BRIG.)

CUTTING-DOWN LINE. The elliptical curve line, forming the upper side of the floor timbers at the middle line of the ship. Also the line that forms the upper part of the knee of the head, above the cheeks. *(See Inboard Works, Plate IV.* on which the cutting down line is represented as limiting the depth of every floor timber at the middle line, and also the height of the upper part of the deadwood afore and abaft.)

CUTWATER. The knee of the head. *(See that Article.)*

CYCLOID. In geometry, a curve of the higher kind, called also *Trochoid,* and generated in the following manner. If the circle C D H roll on the given straight line, A B, so that all the parts of the circumference be applied to it one after another, the point C, that first touched the line A B in A, by a motion thus compounded of a circular and rectilinear motion, will describe the curve A C B, called the cycloid.



DAGGER. A piece of timber that faces on to the poppets on the bildgeways, and crosses them diagonally to keep them together. The plank that secures the heads of the poppets is called the *dagger plank.* The word *dagger* seems to apply to any thing that stands diagonally or aslant.

DAGGER-KNEES. Knees to supply the place of hanging knees. Their side arms are brought up aslant, or nearly to the underside of the beams adjoining. They are chiefly used to the lower deck beams of merchant ships, in order to preserve as much stowage in the hold as possible. Any straight hanging knees, not perpendicular to the side of the beam, are in general termed *dagger knees.* (*See Inboard Works, Plate IV.*)

DAGGER PLANK. (*See* DAGGER, *above.*)

DAVIT. A short beam of fir, trimmed eight square towards the outer-end, and used as a crane, whereby the flukes of the anchor are hoisted to the gunwale without injuring the planks of the side.

DEAD-DOORS. Doors made of whole deal, with slit deal lining, fitted in a rabbet to the outside of the gallery doors, and bolted within side, to prevent the water from flowing into the ship in case the quarter gallery should be carried away.

DEAD-EYES. Oblate pieces of elm, fixed at the outer edges of the channels, with three holes in each of them, through which the laniards of the shrouds are reeved. (*See Sheer Draught, Plate I. and Midship Section, Plate III.*)

DEAD-FLAT. A name given to that timber or frame which has the greatest breadth and capacity in the ship, and which is generally called the *midship bend.* In those ships where there are several frames or timbers of equal breadth or capacity, that which is in the middle should be always considered as *dead-flat,* and distinguished as such by the character ⊕. The timbers before dead-flat are marked A, B, C, &c. in order; and those abaft dead-flat by the figures 1, 2, 3, &c. The timbers adjacent to dead-flat, and which have no rising, are distinguished by the characters (A) (B) &c. and (1) (2) &c. (*See Sheer Draught, Plate I.*)

DEAD-LIGHTS. Shutters for the stern and gallery lights, to prevent the water from gushing into the ship in a high sea. They are made of whole deal, with slit deal linings, fitted on the outside, and bolted or otherwise fastened within, in bad weather.

DEAD-RISING, or RISING LINE OF THE FLOOR. Those parts of the floor or bottom throughout the ship's length, where the sweep or curve at the head of the floor timber is terminated, or inflects to join the keel. Hence, although the rising of the floor at the midship flat is but a few inches above the keel at that place, its height forward and aft increases according to the sharpness of form in the body. Therefore the rising of the floor in the *sheer plan,* is a curve line drawn at the height of the ends of the curve of the floor-timbers, and limited at the main frame, or dead-flat, by the dead-rising; appearing in flat ships nearly parallel to the keel for some timbers afore and abaft the midship frame; for which reason these timbers are called *flats:* but in sharp ships it rises gradually from the main frame, and ends on the stem and post.

DEAD-WATER. The eddy-water which the ship draws after her at her seat, or line of floatation in the water, particularly close aft. To this particular great attention should be paid in the construction of a vessel, especially in those with square tucks, for such being carried too low in the water, will be attended with great eddies or much *dead-water.* Vessels with a round buttock have but little or no dead-water, because, by the rounding or arching of such vessels abaft, the water more easily recovers its state of rest.

DEAD-WOOD. That part of the basis of a ship's body, forward and aft, which is formed by solid pieces of timber scarfed together lengthwise on the keel. These should be sufficiently sided to admit of a stepping or sabbet for the heels of the timbers, that the latter may not be continued downwards to sharp edges; and they should be sufficiently high to seat the floors. Afore and abaft the floors the deadwood is continued to the cutting-down line, for the purpose of securing the heels of the cant-timbers. *(See Sheer Draught, Plate I.)*

DEAD-WORK. *(See* SUPERNATANT.)

DEALS. Fir wood, of similar thickness to plank.

DECKS. The decks are in a ship what floors are in a house. They are to support the artillery, stores, &c. and, with the beams, to connect the ship together. Their names arise from their situation, as *Lower Deck, Middle Deck, Upper Deck,* and *Quarter Deck.* When a deck stretches fore and aft upon one line, without any falls or intervals, it is called a *Flush Deck.* The space before the foremast bulkhead, under the quarter-deck, is often called the *Half Deck;* and, in some north country ships, the steerage is frequently called by this name.

DEEP WAISTED. A term signifying that the height of the topsides is much above the upper deck, as they are in most vessels in the Royal Navy.

DEPTH IN THE HOLD. The height between the floor and the lower deck. This is one of the principal dimensions given for the construction of a ship. It varies according to the height at which the guns are required to be carried from the water; or according to the trade for which a vessel is designed.

DIAGONAL LINE. A line cutting the body-plan diagonally from the timbers to the middle line. It is square with, or perpendicular to, the shape of the timbers, or nearly so, till it meets the middle line. *(See Body Plan, Plate I.)*

DIAGONAL RIBBAND. A narrow plank, made to a line formed on the half-breadth plan, by taking the intersections of the diagonal line with the timbers in the body-plan to where it cuts the middle line in its direction, and applying it to their respective stations on the half-breadth plan, which forms a curve to which the ribband is made as far as the cant body extends and the square frame adjoining. *(See* RIBBANDS.)

DISPOSITION. A draught or drawing representing the several timbers that compose the frame of the ship, so that they may be properly disposed with respect to the ports, &c. *(See Disposition of the Frame in Plate III.)*

DOG. An iron implement used by shipwrights, having a fang at one, or sometimes at each end, to be driven into any piece for supporting it while hewing, &c. Another sort has a fang in one end and an eye at the other, in which a rope may be fastened, and used to haul any thing along.

DOG SHORE. A shore particularly used in launching.

DOUBLING. Planking of ships' bottoms twice. It is sometimes done to new ships when the original planking is thought to be too thin; and, in repairs, it strengthens the ship, without driving out the former fastenings.

DOVE-TAIL. A score at the end of a piece of wood resembling the end of a dove's tail, and into which a corresponding piece is fitted. It is cut larger within than without for the purpose of holding the two pieces together the more firmly. *(See Perpendicular View of the Stern, Plate I.)*

DOVE-TAIL PLATES. Metal plates, formed like dove-tails, and used to confine the heel of the stern-post and keel together.

DOWSING CHOCKS. Pieces fayed athwart the apron and lapped on the knight-heads or inside stuff above the upper deck.

DRAUGHT. The drawing or design of the ship, upon paper, describing the different parts, and from which the ship is to be built. It is mostly drawn by a scale of one quarter of an inch to a foot, so divided or graduated that the dimensions may be taken to one inch. *(See Sheer Draught, Plate I.)*

DRAUGHT OF WATER. The depth of water a ship displaces when she is afloat. *(See Sheer Draught, Plate I.)*

DROP. The fall or declivity of a deck, which is generally of several inches. Drops are also small foliages of carved work in the stern-munions, &c.

DRIFT-PIECES. Solid pieces, fitted at the drifts, to form the scroles. They are commonly mitered into the gunwale, but should rather be let in with square butts, as the caulking will stand better. *(See Sheer Draught, Plate I.)*

DRIFTS. Those parts where the sheer is raised according to the heights of the decks or gangways, and where the rails are cut off and ended by scroles. *(See Sheer Draught, Plate I.)*

DRIVER. The foremost spur on the bilgeways; the heel of which is fayed to the foreside of the foremost poppet, and cleated on the bilgeways, and the sides of it stand fore and aft. It is now seldom used.

DRUMHEAD. The head of a capstan, formed of semi-circular pieces of elm, which, framed together, form the circle into which the capstan bars are fixed. *(See* CAPSTAN.)

DRUXEY. A state of decay in timber with white spungy veins, the most deceptive of any defect.

DUBBING. Working with an adze.

DUMB PINTLE. *(See* PINTLE.)

DUNNAGE-BATTENS. Pieces of oak or fir, about two inches square, nailed athwart the flat of the orlop, to prevent wet from damaging the cables, and to admit air. Dunnage battens are also used in sail-rooms, and in magazines, so as to form a vacant space beneath the sails and powder barrels. DUNNAGE, in general, signifies light wood, or similar materials, used to elevate the stowage.

EARS OF BOATS. The knee-pieces at the fore-part on the outside, at the height of the gunwale. *(See Long Boat, Plate IV.)*

EDGING OF PLANK. Sawing or hewing it narrower.

EKEING. Making good a deficiency in the length of any piece, by scarphing or butting, as at the end of deck-hooks, cheeks, or knees. The *ekeing* at the lower part of the supporter under the cat-head, is only to continue the shape and fashion of that part, being of no other service. We make this remark, because, if the supporter were stopt short without an ekeing, it would be better, as it causes the side to rot, and it commonly appears fair to the eye in but one direction. The EKEING is also the piece of carved work under the lower part of the quarter-piece, at the aft part of the quarter gallery. *(See Sheer Draught, Plate I.)*

ELEVATION. The orthographic draught, or perpendicular plan of a ship, whereon the heights and lengths are expressed. It is called by shipwrights the SHEER DRAUGHT. *(See Plate I.)*

ENTRANCE. A term applied to the fore part of a ship under the load-water line, expressive of its figure; as, "she has a fine entrance," &c.

EVEN KEEL. A ship is said to swim on an even keel when she draws the same quantity of water abaft as forwards.

EYE-BOLT. *(See* BOLTS.)

FACE-PIECE. A piece of elm, generally tabled on to the fore part of the knee of the head, to assist the conversion of the main piece, and likewise to shorten the upper bolts, and prevent the cables from rubbing against them as the knee gets worn.

FACING. Letting one piece, about an inch in thickness, on to another, in order to strengthen it.

FAIR. A term to denote the evenness or regularity of a curve or line.

FALL. The descent of a deck from a fair curve lengthwise, as frequently in the upper deck of yachts, or merchant ships, to give height to the commander's cabin, and sometimes forward at the hawse-holes.

FALLING-HOME, or by some, TUMBLING-HOME. The inclination which the topside has within a perpendicular. *(See* FLAIRING.)

FALSE-KEEL. A second keel, composed of elm-plank, or thick-stuff, fastened in a slight manner under the main keel, to prevent it from being rubbed. Its advantages also are, that, if the ship should strike the ground, the false keel will give way, and thus the main keel will be saved; and it will be the means of causing the ship to hold the wind better. *(See Sheer Draught, Plate I.)*

FALSE-POST. A piece tabled on to the aft part of the heel of the main part of the stern post. It is to assist the conversion and preserve the main post, should the ship tail aground. *(See Sheer Draught, Plate I.)*

FALSE-RAIL. A rail fayed down upon the upperside of the main or upper rail of the head. It is to strengthen the head-rail, and forms the seat of ease at the after end next the bow.

FASHION PIECES. The timbers so called from their fashioning the after part of the ship in the plane of projection, by terminating the breadth and forming the shape of the stern. They are united to the ends of the transoms and to the dead-wood. *(See Sheer Draught, Plate I.)*

To FAY. To join one piece so close to another that there shall be no perceptible space between them.

FENDERS. Two pieces of oak-plank fayed edgeways, perpendicularly, against the topsides abreast the main hatchway, to prevent the sides of the ship from being rubbed by the hoisting of any thing on board. It appears, however, from the construction of these fenders, that their only use, in the Royal Navy, can be, when any thing is to be parbuckled up the side; and, as this is very unusual, most weights being hoisted on board by the yard-tackles, or a derrick, so that the articles never touch the sides, they are of little use, and had better be dispensed with, as they are the means of rotting the sides in the parts on which they are affixed. *(See Sheer Draught, Plate I.)*

FIFE-RAIL. A rail formerly let over the timber-heads above the plank-sheers of the quarter-deck and forecastle, and formerly worked similar to the plank-sheer, but lately planked up to it, excepting the taffarel fife-rail. *(See Stern, Plate I.)*

FIGURE. The principal piece of carved work or ornament at the head of the ship.

FILLING ROOM. A small place in the magazine, lined with lead, and wherein the powder is started loosely to fill the cartridges.

FILLING-TIMBERS. The intermediate timbers between the frames that are gotten up into their places singly after the frames are ribbanded and shored. *(See the Disposition of them in Plate III.)*

FILLINGS. Pieces of fir fayed between the cheeks of the head; and the pieces in general, to which no particular denomination is otherwise given, applied or affixed wherever solidity is required; such as those, of oak, between the floors to which the kelson is fayed; and between the timbers, to receive the chain and preventer bolts, &c.

FINISHINGS. The carved ornaments of the quarter galleries. Those below the lower stool are called the *lower finishings;* and those above the upper stool, the *upper finishings. (See Sheer Draught, Plate I.)*

FIRE-HEARTH. The fire-place and conveniencies in the gallery for cooking the provisions for the people. It is composed of a grate, iron-boilers, ovens, a smoke-jack, &c.

FISH-ROOM. A place parted off in the after-hold, by bulkheads, between the spirit-room, bread-room, and powder-room. It was formerly used for stowing the salt-fish to be consumed on board; a practice long since discontinued. It is now used for the stowage of coals, and sometimes for spirits, when the ship is destined for a long voyage.

FIXED BLOCKS. Those blocks that come through the sides and are bolted, as the sheet, tack, and brace blocks. *(See* BLOCKS.)

FLAIRING. The reverse of *falling* or *tumbling-home.* As this can be only in the fore-part of the ship, it is said that a ship has a *flairing-bow,* when the topside falls outward from a perpendicular. Its uses are, to shorten the cathead, and yet keep the anchor clear of the bow. It also prevents the sea from breaking in upon the forecastle. *(See Fore Body Plan, Plate I.)*

FLATS. A name given to the timbers a-midships that have no bevellings, and are similar to dead-flat, which is distinguished by these characters ⊕ (A) (B) (1) (2) &c. *(See* DEAD FLAT. *See also Sheer Draught, Plate I.)*

FLEXURE. The binding or curving of a line or figure. *(See Inflected Curves.)*

FLIGHT. A sudden rising, or a greater curve than sheer, at the cheeks, catheads, &c.

FLIGHT OF THE TRANSOMS. As the ends or arms of the transoms, being gradually closed in proportion to their distance from the wing transoms downwards, become more narrow as they approach the keel, the general figure or curve which they thus describe, similar to the rising of the floors, is called the *flight of the transoms.*

FLOOR. The bottom of a ship, or all that part on each side of the keel, which approaches nearer to a horizontal than a perpendicular direction, and whereon the ship rests when aground.

FLOOR-HOLLOW. The inflected curve that terminates the floor next the keel, and to which the *floor hollow mould* is made. (*See Long-Boat on Plate IV.*)

FLOOR-RIBBAND. The ribband next below the floor-heads which supports the floors. This ribband should be well shored, and great pains should be taken to keep it fair and level, as the whole fabric depends very much thereon. (*See* RIBBANDS.)

FLOOR-SWEEPS. The radii that sweep the heads of the floors. (*See* FRAMES. *See also Sheer Draught and Body Plan, Plate I.*)

FLOORS, or FLOOR-TIMBERS. The timbers that are fixed athwart the keel, and upon which the whole frame is erected. They generally extend as far forward as the fore-mast, and as far aft as the after square timber; and, sometimes, one or two cant-floors are added. (*See* FRAMES. *See also Midship Section on Plate III.*)

FLUSH. With a continued even surface; as a FLUSH DECK, which is a deck upon one continued line, without interruption, from fore to aft.

FLY-UP. Is a term similar to the article FLIGHT, signifying a sudden deviation upwards from a sheer line, as the clamps of the lower deck *fly-up* abaft to prevent their great sny.

FOOT SPACE RAIL. The rail that terminates the foot of the balcony, and in which the balusters step, if there be no pedestal rail. It rabbets over the ends of the deals of the deck. (*See Sheer Draught and Perpendicular View of the Stern, Plate I.*)

FOOT-WALING, or FUTTLING, or CEILING. The inside plank of the ship's bottom. (*See Midship Section, Plate III.*)

FORE. The distinguishing character of all that part of a ship's frame and materials which lie towards the stem.

FORE AND AFT. In the direction of the ship's length from head to stern.

FORE BODY. That part of the ship's body, afore the midships or dead-flat. (*See* BODIES.) This term is more particularly used in expressing the *figure or shape of* that part of the ship. (*See Body Plan, Plate I.*)

FORE-CASTLE The short deck above the upper deck forward.

FORE-FOOT. The foremost piece of the keel. (*See Sheer Draught, Plate I.*)

FORE-LOCK. A thin circular wedge of iron, used to retain a bolt in its place, by being thrust through a mortise hole at the point of the bolt. It is sometimes turned or twisted round the bolt to prevent its drawing.

FORE-MOST. Nearest to the head of the ship.

FORE-PECK. Close forward under the lower deck.

FORK-BEAM. (*See* BEAMS.)

FORWARD. In the fore-part of the ship.

FOXEY. A defect in timber, of a reddish cast or hue, proceeding from over-age, &c.

FRAMES. The bends of timber which form the body of the ship, each of which is composed of one *floor-timber*, two or three *futtocks*, and a *top-timber* on each side; which, being united together, form the frame. Of these frames or bends, that which incloses the greatest space is called the *midship* or *main frame* or *bend*. The arms of the floor-timber form a very obtuse angle; and, in the other frames, this angle decreases or gradually becomes sharper, fore and aft, with the middle line of the ship. Those floors which form the acute angles afore and abaft are called the *rising-floors*. (*See Body Plan, Plate I. and Midship Section, Plate III.*)

A frame of timbers is commonly formed by arches of circles called *sweeps*, of which there are generally five. 1st. The *floor-sweep*, which is limited by a line in the body-plan, perpendicular to the plane of elevation, a little above the keel; and the height of this line above the keel is called the *dead-rising*. The upper part of this arch forms the head of the floor-timber. 2d. The *lower breadth sweep*; the centre of which is in the line representing the lower height of breadth. 3d. *The reconciling sweep*; this sweep joins the two former, without intersecting either; and makes a fair curve from the lower height of breadth to the rising line. If a straight line be drawn from the upper edge of the keel to cut the back of the floor-sweep, the form of the midship frame below the lower height of breadth will be obtained. 4th. The *upper breadth sweep*; the centre of which is in the line representing the upper height of breadth of the timbers. This sweep, described upwards, forms the lower part of the top-timber. 5th. The *top-timber sweep*, or *back-sweep*, is that which forms the hollow of the top-timber. This hollow is, however, very often formed by a mould, so placed as to touch the upper breadth sweep, and pass through the point, limiting the half-breadth of the top-timber.

FRAME TIMBERS. The various timbers that compose a frame bend; as the floor-timber, the first, second, third, and fourth, futtocks, and top-timber, which are united, by a proper shift, to each other, and bolted through each shift. They are often kept open, for the advantage of the air, and fillings fayed between them in wake of the bolts. Some ships are composed of frames only, and are supposed to be of equal strength with others of larger scantling. (*See Disposition, and Midship Section, Plate III.*)

FRIEZING. The ornamental carving or painting above the drift-rails, and likewise round the stern or bow. It is generally a representation of foliage or emblematic trophies of war, &c.

FULCRUM. The prop of support of a lever in lifting or removing a heavy body.

FURRENS. Pieces to supply the deficiency of timber the moulding way.

FUTTLING. (*See* FOOTWALING.)

FUTTOCKS. The separate pieces of timber of which the frame timbers are composed. They are named according to their situation, that nearest the keel being called the first futtock, the next above, the second futtock, &c. (*See* FRAMES. *See also Midship Section, Plate III.*)

GALLERY. The long narrow compartment, or balcony, projecting from the stern and quarters of a large ship. The stern gallery is usually decorated with a balustrade. (*See* QUARTER GALLERIES. *See also Sheer-Draught, Plate I.*)

GALLEY. The place appointed for the fire-hearth and the use of the cooks. It is generally under the forecastle or the fore-part of the ship.

GAMMONING-HOLE. A mortise hole cut through the knee of the head, between the cheeks, through which the rope passes that gammons the bowsprit. (*See Head, Plate I.*)

GANG-BOARDS. The narrow platforms within the sides, next the gunwales, which connect the quarter-deck to the forecastle. Each is composed of three or four Prussia deals fayed and bolted together edgewise.

GANGWAY. The entrance into the ship by the steps on the side, which, of course, is best when flush with the quarter-deck. *(See Sheer Draught, Plate I.)*

A FIXT GANGWAY is a continuation of the quarter-deck to a knee before it, so as to form the gangway when the quarter-deck of itself reaches not forward enough. There is sometimes a fixed gangway, made at the aftpart of the forecastle in large ships, when the waist is longer than the customary length of a deal.

GARLANDS. *(See* SHOT GARLANDS.)

GARBOARD STRAKE. That strake of the bottom which is wrought next the keel, and rabbets therein. *(See Planking, Plate III.)*

GOOGINGS or GUDGEONS. The hinges upon which the rudder traverses. *(See Rudder, in Sheer Draught, Plate I.)* Also the metal pieces upon which a windlass works.

GOOSE-NECK. A large iron hook, fixed with a strap at the after end of the main channel, to stow the studding sail boom in.

A SHIFTING GOOSE NECK is a sort of iron cleat, confined near the foremost end of the tiller, by means of thin iron plates, one on each side, which are bolted through the tiller, so that the goose-neck may move forward between the plates as in a groove. Its use is to shift forward as the tiller may shrink and go aft, to be kept fast in the rudder. The goose-neck is fastened by two screw eye-bolts, which go through it and jamb it upon the tiller.

GRAIN-CUT. Cut athwart the grain; as when the grain of the wood does not partake of the shape required; for instance, if a knee be cut out of a broad straight-grained plank, it is evident that the grain, being cut across, would be very short in one or both arms.

GRATINGS. The lattice coverings of the hatchways, which are made with openings to admit air, or light, by cross battens and ledges. The openings should never be so large as to admit the heel of a man's shoe, as they may otherwise endanger those that pass over them.

GRIPE. A piece of elm timber, that completes the lower part of the knee of the head, and makes a finish with the fore-foot. It bolts to the stem, and is farther secured by two plates of copper in form of a horse-shoe, and therefore called by that name. *(See Sheer Draught, Plate I.)*

GROMMETS. (FOR BOATS.) Wreaths of rope which confine the oars to the pins in the gunwale.

GROUNDWAYS. Large pieces of timber, generally defective, which are laid upon piles driven in the ground, across the dock or slip, in order to make a good foundation to lay the blocks on, upon which the ship is to rest.

GUARD-IRONS. Curved or arched bars of iron fixed over the carved work of yachts, &c. particularly over the head and quarter pieces, to prevent their being damaged.

GUNNER'S STORE ROOM. *(See* STORE ROOMS.)

GUN ROOM. The after-part of the lower deck, parted off for the accommodation of the subaltern officers.

GUNWALE. That horizontal plank which covers the heads of the timbers between the main and fore drifts. *(See Sheer Draught, Plate I.)*

GUY. A rope extended from the head of sheers, and made fast at a distance on each side, by which they are kept steady.

HAIR BRACKET. The moulding which terminates the fore ends of the head rails, comes at the back of the figure, and breaks in fair with the upper cheek. *(See Sheer Draught, Plate I.)*

HALF-BREADTH-PLAN. *(See* PLAN.)

HALF-BREADTH OF THE RISING. A curve in the floor plan, which limits the distances of the centres of the floor-sweeps from the middle line of the body-plan. *(See Half Breadth Plan, Plate I.)*

HALF-PORTS. A sort of shutters made of deal, and fitted to the slope of those ports which have no hanging lids. They have a hole cut in them for the gun to go through.

HALF-TIMBERS. The short timbers in the cant-bodies, which are answerable to the lower futtocks in the square body. *(See Disposition in Plate III.)*

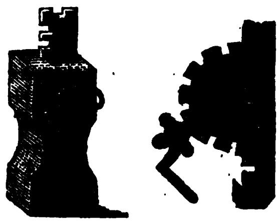
HAMMACOE, or HAMMOCK-RACKS. The battens nailed to the sides of the beams, and to which the sailors hang their hammocks and bedding.

HAMMERS. The tools used by shipwrights for driving nails and clenching bolts. *Claw-hammers* are the most convenient for the former purpose, having a claw at one end to draw the nail out if it splits or rucks in driving. *Clench-hammers* should be made of hard steel, with one end flat for clenching, and a face for smoothing the clench.

HANCE or HANCH. A sudden fall or break, as from the drifts forward and aft to the waist. Also those breaks in the rudder, &c. at those parts where it suddenly becomes narrower. *(See Sheer Draught, Plate I.)*

HANDSPEC. A wooden bar, made of tough ash, and used as a lever to prize or remove great weights.

HAND SCREWS or JACKS, DOUBLE or SINGLE. The engine represented in the margin, used to cant beams, or other weighty timbers. It consists of a box of elm, containing cogged iron wheels, of increasing powers. The outer one, which moves the rest, is put in motion by a winch on the outside, and is called either single or double, according to its increasing force. The outer figure here shewn represents the inside work separately.



HANGING. Declining in the middle part from a horizontal right line, as the hanging of the decks, hanging of the sheer, &c.

HANGING-CLAMP. A semi-circular iron, with a foot at each end, to receive nails, by which it is fixed to any part of a ship, to hang stages to, &c.

HANGING-KNEE. Those knees against the sides whose arms hang vertically or perpendicularly. *(See Midship Sections, Plate III.)*

HARPINS. Pieces of oak similar to ribbands, but trimmed and bevelled to the shape of the body of the ship, and holding the fore and after cant bodies together until the ship is planked. But this term is mostly applicable to those at the bow; hence arises the phrase "clean and full harpins," as the ship at this part is more or less acute. *(See Fore-part of the Half-breadth Plan, Plate I.)*

HARRIS-CUT. This term is applied when the edges of planks are cut to an under bevelling, to fay one upon another, as the birthing or sides of the well, so that no ballast may get in at the joints.

HATCHES. The coverings for the hatchways.

HATCHWAYS. The square or oblong openings in the middle of the decks, for the convenience of lowering down goods; forming also the passages from one deck to another and into the hold, &c. *(See Plans of Decks, Plates III. and IV.)*

HAWSE-HOOK. The breasthook over the hawse-holes. *(See Inboard Works, Plate IV.)*

HAWSE-PIECES. The timbers which form the bow of the ship, whose sides stand fore and aft or nearly so; that is, parallel to the middle line of the ship. *(See Sheer Draught, Plate I.)*

HEAD. The upper end of any thing; but more particularly applied to all the work fitted afore the stem, as the figure, the knees, rails, &c. *(See Sheer Draught, Plate I.)*

A SCROLL HEAD signifies that there is no carved or ornamental figure at the head, but that the termination is formed and finished off by a *volute*, or scroll turning outwards. A FIDDLE HEAD signifies a similar kind of finish, but with the scroll turning aft or inwards.

HEAD-LEDGES. The thwartship pieces which frame the hatchways and ladderways. *(See Plans, Plates III. and IV.)*

HEAD-RAILS. Those rails in the head which extend from the back of the figure to the cat-head and bows, which are not only ornamental to the frame but useful to that part of the ship. *(See Sheer Draught, Plate I.)*

HEAD-TIMBERS. The pieces that cross the rails of the head vertically. They are bolted through their heels to the cutting down of the knee, and unite the whole together. *(See Sheer Draught, Plate I.)*

HEEL. The lower end of a timber, &c. A ship is also said to *heel* when she is not upright.

HEIGHT OF BREADTH LINES, UPPER and LOWER. The two curved lines described on the sheer-plan, at the height of the main-breadth, or broadest part of the ship, at each timber. In the body-plan, they are horizontal lines at those heights on which the main-breadths of each timber are set off. In those lines are found the centres for sweeping the lower and upper breadth sweeps. *(See* MAIN BREADTH. *See also Sheer Draught, and Body Plan, Plate I.)*

HELM. The whole of the machinery astern, which serves to steer or guide the ship, as the rudder, the tiller, the wheel, &c.

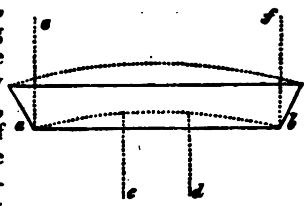
HELM-PORT. That hole through the counter, through which the head of the rudder passes. *(See Sheer Draught, Plate I.)*

HELM-PORT TRANSOMS. The piece of timber placed athwart the inside of the counter timbers at the height of the helm-port. It is bolted through every stern timber, and kneed at each end for the security of that part of the ship. *(See Perpendicular View of the Stern, in Plate I.)*

HELVE. The handle of axes, adzes, mauls, &c.

HOGGING. (*See* BROKEN BACKED.) A ship is said to *hog* when the middle part of her keel and bottom are so strained as to curve or arch upwards. This term is therefore opposed to *sagging*, which, applied in a similar manner, means by a different sort of strain, to curve downwards.

In order to elucidate this subject, let us suppose a vessel to be acted upon by several forces as in the figure *a b*, with the forces or weight, *e*, *f*, acting downwards, and *c d*, the pressure of the water, acting upwards; the vessel may in this state be maintained in equilibrio, provided that it has a sufficient degree of strength; but, so soon as it begins to give way, we see that it must bend in a convex manner, since its middle would obey the forces *c* and *d*, acting upward, whilst its extremities would be actually forced downwards by the forces or weights *e* and *f*.



Vessels deficient in strength are generally found in such a situation; and, since similar effects continually act whilst the vessel is immersed in the water, it has happened but too often that the keel has experienced the bad effect of a strain.

Hence it is evident, that *hogging* may arise either from want of strength in the component parts of a vessel, or from disarrangement in the stowage.

Many long, deep, straight floored vessels, too slightly built, have been found to hog, owing to the great upward pressure of the water upon the broad part of the bottom; and it has been found that, the longer and larger ships are, the more easily have their bottoms bent or hogged, even when the stowage has been correct; and much more so when it has been unequally distributed towards the head and stern.

Ships deeply laden, with very heavy cargoes or materials nearly amidships, have, on the contrary, been sometimes found to *sag* downwards, in proportion as the weight of the cargo has exceeded the upward pressure of the water.

But, according to the present practice of building in Great Britain, these disadvantages are little to be feared; although, in a less advanced state of the art, they were frequently found in British vessels, and are still as frequently found in vessels of foreign construction; many of the latter being of too small scantlings and too slightly constructed. Even sharp built vessels of this country, upon the present construction, are seldom found to hog; and we presume that no vessel constructed agreeably to the Table of Dimensions and Scantlings, given hereafter, will be found so to do. But it is to be particularly observed, that these dimensions, with respect to the strength of the body, will not admit of diminution.

If, however, the *relative* dimensions be changed; and, if the length be increased, as recommended in some cases, in order to produce an increase in the velocity, or, if the ship is intended to be laden with very heavy materials, as lead, &c. the strength may be proportionably increased by enlarging the scantlings of the thickstuff at the joints of the timbers, &c.

HOLD. That part of the ship below the lower deck, between the bulk-heads, which is reserved for the stowage of ballast, water, and provisions, in a ship of war; and for that of the cargo, in merchant vessels.

HOLLOW-MOULD. The same with *Floor-hollow*, which see. Sometimes the back sweep which forms the upper part of the top-timber is called the *top-timber hollow*.

HOOD. The name given to all the foremost and aftermost planks of the bottom, both withinside and without. Also a covering to shelter the mortar in bomb-vessels. In merchant ships it is the birthing round the ladderway. (*See* COMPANION.)

HOODING-ENDS. These ends of the planks which bury in the rabbets of the stem and stern post.

HOOK of the DECKS. (*See* BREAST-HOOKS.)

HOOKING. The act of working the edge of one plank, &c. into that of another, in such a manner that they cannot be drawn asunder endways. (*See Kelson Scarphs, Inboard Works, Plate IV. and Planking, Plate III.*)

HORIZONTAL RIBBANDS. Those ideal ribbands, used in laying off, which are taken off level or square with the middle line of the ship's body. (*See* RIBBANDS.)

HORN or HORNING. Placing or proving any thing to stand square from the middle line of the ship, by setting an equal distance thereon from each side of the middle line; then bringing the same distance equally from some fixed spot in the middle line by a batten or staff of some length.

HORSE. The round bar of iron which is fixed to the main rail and back of the figure in the head, with stantions, and to which is attached a netting for the safety of the men who have occasion to be in the head. Also the cross-pieces of timber tenoned on to the heads of the bitts for the booms to rest upon.

HORSE-IRON. An iron fixed in a handle, and used with a beetle by caulkers, to *horse-up* or harden in the oakhams.

HORSE-SHOES. Large straps of iron or copper shaped like a horse-shoe and let into the stem, which gripe on opposite sides, through which they are bolted together to secure the gripe to the stem.

HULL. The whole frame or body of a ship, exclusive of the masts, yards, sails, and rigging.

JAMBS, for fixing the LIGHTS. Thick broad pieces of oak, fixed up endways, and between which the magazine lights are fitted.

IN AND OUT. A term sometimes used for the scantling of the timbers the moulding way, but more particularly applied to those bolts in the knees, riders, &c. which are driven through the ship's sides, or athwartships, and therefore called "*In and out Bolts.*"

INBOARD. Within the ship; as the *Inboard Works, &c.* (*See Plate IV.*)

INNER POST. A piece of oak timber, brought on and fayed to the foreside of the main stern-post, for the purpose of seating the transoms upon it. It is a great security to the ends of the planks, as the main post is seldom sufficiently afore the rabbet for that purpose, and is also a great strengthener to that part of the ship. (*See Inboard Works, Plate IV.*)

INTERSECTION. The point in which one line crosses another.

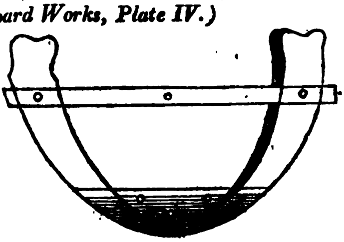
JOINT. The place where any two pieces are united. This term is, however, more particularly used to express the lines which are laid down in the mould-loft for the purpose of making the moulds for the timbers, as those lines exhibit the shape of the body between every two timbers, which is hence called the *joints*.

IRONS. The tools used by the caulkers for driving in the oakum.

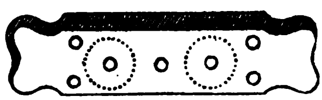
KEEL. The main and lowest timber of a ship, extending longitudinally from the stem to the stern-post. It is formed of several pieces, which are scarphed together endways, and form the basis of the whole structure, of course it is usually the first thing laid down upon the blocks for the construction of the ship. *(See Sheer Draught, Plate I.)*

KEEL STAPLES. *(See* Staples.)

KEELSON, or, more commonly, KELSON. The timber formed of long square pieces of oak, fixed within the ship exactly over the keel) and which may therefore be considered as the counter part of the latter (for binding and strengthening the lower part of the ship, for which purpose it is fitted to, and laid upon, the middle of the floor-timbers, and bolted through the floor and keel. *(See Inboard Works, Plate IV.)*



KEVELS. Pieces of oak plank, shaped like timber heads, and fixed into mortises cut through other pieces that are fastened to the insides of the ship. They answer the purpose of timber heads to belay the ropes to.



KEVEL, or CAVEL HEAD BLOCKS. A sort of blocks, having a sheave hole or two cut through fore and aft, and which are bolted to the ship's sides, nearly opposite the masts, to reeve the lifts, &c.

KEY. A dry piece of oak, &c. cut tapering, to drive into scarphs that have hook-butts.

KILN. A convenience for heating planks to make them pliable. A *steam-kiln* is a trunk composed of deals, grooved neatly into each other, which is generally from three to four feet square, and from forty to sixty feet in length, having a door at each end. It is confined together by bolts driven through it at certain distances, which answer for bearers to rest the plank upon, and it is supported upon brick work. Beneath it, in the middle, is a large iron or copper boiler, or sometimes two boilers, which are then fixed near each end, the steam from which, issuing into the trunk, enters the pores of the plank and makes it pliable.

A BOILER KILN is shaped similar to the former, but with an open top. It is formed of sheets of copper rivetted together, and is fixed in brick work. Under each end, or in the middle, are furnaces to make the water boil, when the plank is in. The upper part is covered with shutters that are hoisted occasionally by small tackles. The dimensions, &c. of a copper boiler in one of the royal yards are, length, forty feet; breadth at the ends, four feet three inches; and in the middle, six feet; depth, two feet ten inches; and weight, fifty-three cwt. three quarters, and seven pounds.

KNEES. The crooked pieces of oak timber, by which the ends of the beams are secured to the sides of the ship. Of these, such as are fayed vertically to the sides are called *hanging-knees*, and such as are fixed parallel to, or with the hang of the deck, are called *lodging-knees*. *(See Midship Section, Plate III. and Plans of the Deck, Plates III. and IV.)*

KNEE TIMBER. That sort of crooked timber which forms, at its back or elbow, an angle of from forty-five to twenty-four degrees. The more acute this angle is, the more valuable is the timber on that account. But if their angle be more obtuse, they are said to be *raking*, and are proportionably less valuable, being of the less utility for the formation of knees, &c.

KNEE OF THE HEAD. The large flat timber fayed edgeways upon the fore-part of the stem. It is formed by an assemblage of pieces of oak coaked or tabled together edgewise, by reason of its breadth, and it projects the length of the head. Its fore-part should form a handsome serpentine line, or inflected curve. The principal pieces are named the *main-piece* and *lacing*. *(See Sheer Draught, Plate I.)*

KNIGHT-HEADS, or BOLLARD-TIMBERS. Large oak timbers fayed and bolted to each side of the stem, the heads of which run up sufficiently above the head of the stem to support the bowsprit, care being taken to cast them sufficiently open above the stem to the diameter of the bowsprit. *(See Sheer Draught, Plate I.)*

KNUCKLE. A sudden angle made on some timbers by a quick reverse of shape, such as the knuckles of the counter timbers. *(See Sheer Draught, Plate I.)*

KNUCKLE-TIMBERS. Those top-timbers in the fore-body whose heads stand perpendicular, and form an angle with the flair or hollow of the topside. This work is the best when the touch or knuckle is at the plank sheer. *(See Fore-body in Plate I.)*

LABOURSOME. Subject to labour, or to pitch and roll violently in a heavy sea, by which the masts and even the hull may be endangered. For by a successive heavy roll the rigging becomes loosened, and the masts at the same time may strain upon the shrouds with an effort which they will be unable to resist; to which may be added, that the continual agitation of the vessel loosens her joints, and makes her extremely leaky.

LACING. One of the principal pieces that compose the knee of the head, which runs up to the top of the hair-bracket, and to which the figure and rails of the head are secured.

LADDERS. Ladders are in a ship for the same purpose as stairs in a house, for the convenience of ascending or descending from one deck to another.

LADDER-WAYS. The openings in the decks wherein the ladders are placed. *(See Plans, Plate III.)*

LANDING-STRAKE, in BOATS. The upper strake but one.

LANTERNS. The machines made of tin and glass, to contain candles for the transmission of light to those parts of the ship where an unscreened candle cannot be placed, or where it would be dangerous, as on the poop, in the magazine, store-rooms, &c.

To LAP OVER or UPON. The mast carlings are said to lap upon the beams by reason of their great depth, and head-ledges at the ends lap over the coamings.

LAPS. The remaining part of the ends of carlings, &c. which are to bear a great weight or pressure, such as the capstan-step. *(See Inboard Works, Plate IV.)*

LAP-SIDED. A term expressive of the condition of a vessel when she will not swim upright, owing to her sides being unequal.

LARBOARD-SIDE. The left-hand side of the ship, when looking forward from the stern.

LAUNCH. The slip or descent whereon the ship is built, including the whole of the machinery used in launching. *(See Frontispiece.)*

LAUNCH. A large boat now mostly used instead of the LONG BOAT. *(See* LONG BOAT.)

LAUNCHING. The act of sending the ship from off the slip into the water.

LAUNCHING-PLANKS. A set of planks mostly used to form the platform on each side of the ship, whereon the bilgeways slide for the purpose of launching. *(See Frontispiece.)*

LAYING-OFF, or LAYING-DOWN. The act of delineating the various parts of the ship, to its true size, upon the mould-loft floor, from the draught given, for the purpose of making the moulds. *(See* MOULDS.)

LAZARETTO. A name given to an hospital-ship for the reception of the sick, or of persons supposed to be infectious. It is also the name of a place parted off at the fore-part of the lower deck, in some merchant ships, for the convenience of laying up the provisions, stores, &c. necessary for the voyage.

LEAN. The same with CLEAN, which see.

LEDGES. Oak or fir scantling used in framing the decks, which are let into the carlings athwartships. The ledges for gratings are similar, but arch or round up agreeable to the head-ledges. *(See Lower Deck Plan, Plate IV.)*

LENGTHENING. The operation of separating a ship athwartships, and adding a certain portion to her length. It is performed by clearing or driving out all the fastenings in wake of the butts of those planks which may be retained, and the others are cut through. The after-end is then drawn apart to a limited distance equal to the additional length proposed. The keel is then made good, the floors crossed, and a sufficient number of timbers raised to fill up the vacancy produced by the separation. The kelson is then replaced to give good shift to the new scarphs of the keel, and as many beams as may be necessary are placed across the ship in the new interval, and the planks on the outside are replaced with a proper shift. The clamps and foot-waling within the ship are then supplied, the beams kneed, and the ship completed in all respects as before.

To LET-IN. To fix or fit one timber or plank into another, as the ends of carlings into the beams, and the beams into the clamps, scores being made in each to receive the other.

LEVEL, HORIZONTAL; or as a base square with a perpendicular.

LEVEL LINES. Lines determining the shape of a ship's body horizontally, or square from the middle line of the ship.

LEVELLED-OUT. A line continued out, in a horizontal direction, from the intersection of an angle; or, where the cant-timbers may intersect the diagonal or ribband lines. *(See Fore Body, Plate I.)*

LEVER. A bar of iron or wood to raise weights. The first and most simple of the mechanic powers. *(See* MECHANICS.)

LIEUTENANT'S STORE-ROOM. An apartment fitted up with shelves, bins, and lockers, on the starboard side of the after platform, for the use of the first lieutenant.

LIGHT-ROOM. A small place parted off from the magazine, and in which the lights for lighting the magazine are contained.

LIGHT WATER-LINE. *(See* WATER-LINES.)

LIMBER-BOARDS. *(See* LIMBER-PASSAGE.)

LIMBER-HOLES. *(See the next Article.)*

LIMBER-PASSAGE. A passage or channel formed throughout the whole length of the floor, on each side of the kelson, for giving water a free communication to the pumps. It is formed by the LIMBER-STRAKE on each side, a thick strake wrought next the kelson, from the upper-side of which the depth in the hold is always taken. This strake is kept about eleven inches from the kelson, and forms the passage fore and aft, which admits the water with a fair run to the pump-well. The upper part of the limber passage is formed by the LIMBER BOARDS, which are made to keep out all dirt and other obstructions. These boards are composed of short pieces of oak plank, one edge of which is fitted into a rabbet into the limber-strake, and the other edge bevelled with a descent against the kelson. They are fitted in short pieces for the convenience of taking up one or more, readily, in order to clear away any obstruction in the passage. When the limber boards are fitted, care should be taken to have the butts in those places where the bulkheads come, as there will be then no difficulty in taking those up which come near the bulkheads. A hole is bored in the middle of each butt to admit the end of a crow for prizing it up when required. To prevent the boards from being displaced, each should be marked with a figure corresponding with one on the limber-strake. *(See Midship Section, Plate III.)*

LIMBER-HOLES are square grooves cut through the underside of the floor-timber, about nine inches from the side of the keel on each side, through which water may run toward the pumps, in the whole length of the floors. This precaution is requisite in merchant ships only, where small quantities of water, by the heeling of the ship, may come through the ceiling and damage the cargo. It is for this reason that the lower futtocks of merchant ships are cut off short of the keel.

To LINE. To cover one piece with another. Also to mark out the work, or make lines upon the floor with a chalked line.

LINE OF FLOATATION. *(See* WATER LINES.)

LIPS OF SCARPHS. The substance left at the ends, which would otherwise become sharp, and be liable to split; and, in other cases, could not bear caulking as the scarphs of the keel, stem, &c.

LOAD-WATER LINE. *(See* WATER LINES.)

LOBBY. A name sometimes given to an apartment close before the great cabin bulkhead.

LOCKERS. Small compartments, built of deal, in the cabins and store-rooms. (*See* Shot Lockers.)

LONG BOAT. The largest and stoutest belonging to a ship. (*See* Boats.)

LONG TIMBERS. Those timbers afore and abaft the floors, which form the floor and second futtock in one. (*See Sheer Draught, Plate I.*)

LOOP-HOLES. Small apertures through the bulk-heads, coamings, head-ledges, and other parts of merchant ships, through which the small arms are fired on an enemy who boards at close quarters.

LOOVERED BATTENS. The battens that inclose the upper part of the well, which are fixed at such an angle as to admit air, and yet prevent any dirt from being thrown into the well.

LOOVER-WISE or LOOVER-WAYS. To place battens or boards at a certain angle, so as to admit air but not wet. The loovered or battened parts of ships'-wells are fixed in this manner to admit air and prevent persons from throwing filth of any kind into the well.

LOWER BREADTH SWEEP. (*See* Frames.)

LUFFER LOOF. The fullest or roundest part of the bow.

MAGAZINE. The apartment used to lodge the powder in; which, in large ships, is situated forward, and in small ships abaft. It should always be situated as low down as possible.

MAIN. Chief or principal, as opposed to any thing secondary or inferior. Thus the main-mast is used in contradistinction to the fore or mizen-mast; the main-keel, main-wales, main-hatchway, &c. are in like manner distinguished from the false-keel, channel-wales, and the fore and after hatchways, &c.

MAIN-BREADTH. The broadest part of the ship at any particular timber or frame, which is distinguished on the sheer-draught by the upper and lower heights of breadth lines. (*See Sheer Draught, Plate I.*)

MAIN HALF-BREADTH. Half of the main-breadth, and thus called, because it is necessary to lay down on the plan but half of the figure of the ship, both sides being exactly alike. (*See Sheer Draught, Plate I.*)

MAIN-KEEL. The term of distinction between the keel and the false-keel.

MAIN-POST. The same with Stern Post, and used to distinguish it from the false-post and inner-post.

MAIN-WALES. The lower wales, which are generally placed on the lower breadth, and so that the main-deck knee-bolts may come into them. (*See* Wales.)

MALLET. A sort of wooden hammer, too well known to need description. The mallet used by caulkers to drive the oakum into the seams is in general very different from that of shipwrights, as it is longer and more cylindrical, and is hooped with iron at each end of the head, to prevent its splitting and wearing in the exercise of caulking. North-country shipwrights, who generally practise both branches, use the last-mentioned mallet upon all occasions.

MANGER. An apartment extending athwart the ship immediately within the hawse-holes. It serves as a fence to interrupt the passage of water which may come in at the hawse-holes, or from the cable when heaving in; and the water thus prevented from running aft is returned into the sea by the manger scuppers, which are larger than the other scuppers on that account.

MARGIN-LINE. A line or edge parallel to the upper-side of the wing-transom, and about five inches below it, at which place terminate all the butts of the bottom planks abaft. The latter are made good by the tuck-rail. (*See Perpendicular View of the Stern, Plate I.*)

MARINE CLOTHING ROOM. An apartment built on the larboard side of the after platform to receive the clothing of the marines.

MAST-CARLINGS. Those large carlings which are placed at the sides of the mast-rooms for the purpose of framing the partners. (*See* CARLINGS.)

MASTS. The long cylindrical pieces of timber, elevated upon the keel, and to which the yards and sails, &c. are attached. (*See Sheer Draught, Plate I.*)

MAULS. Large hammers used for driving treenails, having a steel face at one end, and a point or pen drawn out at the other, and hence called a pin-maul. Double-headed mauls have a steel face at each end, of the same size, and are used for driving of bolts, &c.

MESSENGER. A large cable laid rope used to heave in the cable by the main capstan.

META-CENTRE. That point in a ship above which the centre of gravity must by no means be placed; because, if it were, the vessel would be liable to overset. The *meta-centre*, which has also been called the *shifting-centre*, depends upon the situation of the centre of cavity; for it is that point where a vertical line drawn from the centre of cavity cuts a line passing through the centre of gravity, and is perpendicular to the keel. (*See* CENTRE.)

MIDDLE LINE. A line dividing the ship exactly in the middle. In the horizontal or half-breadth plan it is a right line bisecting the ship from the stem to the stern-post; and, in the plane of projection, or body-plan, it is a perpendicular line bisecting the ship from the keel to the height of the top of the side.

MIDDLE TIMBER. That timber in the stern which is placed in midships.

MIDDLE WALES. The three or four thick strakes worked along each side, between the lower and middle deck ports in three-decked ships. (*See* WALES.)

MIDSHIPS. The middle of the ship, either with regard to her length or breadth. (*See* AMIDSHIPS.)

MIDSHIP-BEND or FRAME. That bend which is called *Dead-Flat*. (*See* BENDS. *See also Midship Section, Plate III.*)

MITERED. If two pieces of wood, &c. be joined so as to make a right angle, and the two ends be put together so as to form a line making an angle of 45 degrees, the joint is said to be mitered.

MIZEN-MAST. That mast, in a three-masted vessel, which is nearest the stern. (*See Sheer Draught, Plate I.*)

MONKEY. A machine composed of a long pig of iron, traversing in a groove, which is raised by a pully, and let fall suddenly on the head of large bolts, for driving them in when the weight of mauls would be insufficient; such, for instance, as the dead-wood bolts, or the bolts that are driven in the knee of the head. This sort of monkey generally has a frame with handles, with a groove on the underside; it slides upon a ridge of iron fixed in a bed, and is drawn backwards and forcibly forwards by a rope on each side.

MOOTING. Making a treenail exactly cylindrical to a given size or diameter called the *moot*. Hence, when so made, it is said to be *mooted*.

MORTISE. A hole or hollow made of a certain size and depth in a piece of timber, &c. in order to receive the end of another piece with a tenon fitted exactly to fill it.

MOTION, &c. Belongs to the chapter on mechanics.

MOULDS. Pieces of deal or board made to the shape of the lines on the mould loft floor, as the timbers, harpins, ribbands, &c. for the purpose of cutting out the different pieces of timber, &c. for the ship. Also the thin flexible pieces of pear-tree or box, used in constructing the draughts and plans of ships, which are made in various shapes; viz. to the segments of circles from one foot to 22 feet radius, increasing six inches on each edge, and numerous elliptical curves with other figures *.

MOULDED. Cut to the mould. Also the size or bigness of the timbers that way the mould is laid. (*See* SIDED.)

MOULDING. The act of marking out the true shape of any timber from the mould. Also any ornamental projections, as the rails, finishing, &c.

MOULD-LOFT. A place in building yards appropriated for laying off ships to their full size, for the purpose of making the moulds from which the whole frame, &c. is provided. The floor is one large even flat surface, and in general painted black, that the various lines may more easily be discerned. Some in laying off ships rase the lines in with a pointed instrument, while others only chalk them in. The size of mould-lofts are various, those in the royal yards are very large and commodious, but those in merchant yards are generally about 100 feet long and 30 feet wide.

MUNIONS or MIMTONS. The pieces that divide the lights in the stern and quarter galleries. (*See Sheer Draught, Plate I.*)

NAILS. Iron pins of various descriptions for fastening board, plank, or iron work; viz. *Deck Nails*, or *Spike Nails*, which are from 4 inches and a half to 12 inches long, have snug heads, and are used for fastening planks and the flat of the decks. *Weight Nails* are similar to deck nails, but not so fine, have square heads, and are used for fastening cleats, &c. *Ribband Nails* are similar to weight nails, with this difference, that they have large round heads, so as to be more easily drawn. They are used for fastening the ribbands, &c. *Clamp Nails* are short stout nails, with large heads, for fastening iron clamps. *Port Nails*, double and single, are similar to clamp nails, and used for fastening iron work. *Rudder Nails* are also similar, but used chiefly for fastening the pintles and braces. *Filling Nails* are generally of cast iron, and driven very thick in the bottom planks instead of copper sheathing. *Sheathing Nails* are used to fasten wood sheathing on the ship's bottom, to preserve the plank,

* Moulds, &c. of every sort requisite for marine drawing may be had at STEEL's Navigation Warehouse, Little Tower-Hill, London.

and prevent the filling nails from tearing it too much. *Nails of sorts* are 4, 6, 8, 10, 24, 30, and 40 penny nails, all of different lengths, and used for nailing board, &c. *Scupper Nails* are short nails, with very broad heads, used to nail the flaps of the scuppers. *Lead Nails* are small round-headed nails for nailing of lead. *Flat Nails* are small sharp-pointed nails, with flat thin heads, for nailing the scarphs of moulds. *Sheathing Nails* for nailing copper sheathing are of metal, cast in moulds, about one inch and a quarter long; the heads are flat on the upperside and counter-sunk below: the upperside is polished to obviate the adhesion of weeds. *Boat Nails*, used by boat-builders, are of various lengths, generally rose-headed, square at the points, and made both of copper and iron.

NARROWING OF THE FLOOR SWEEPS. *(See* Rising Half Breadth.)

NAVAL-HOODS. Broad pieces of oak, from 6 to 10 inches thick, (according to the size of the ship,) worked afore the hawse-holes on the outside of the ship, and likewise above and below them, in those ships which have no cheeks to support a bolster; the naval-hoods thus formed answering the same purpose.

NECKING. A small neat moulding at the foot of the taffarel over the light. *(See Stern, Plate I.)*

NEWELL. An upright piece of timber to receive the tenon of the rails that lead from the breasthook to the gangway.

NOG. A treenail projecting from the bottom of the ship as a stop to the heads of shores. Also a treenail driven through the heels of shores into the slip to secure them.

NOGGING. The act of securing the heels of the shores.

NORMAN. A square fid of oak, or short carling, fixed through the head of the rudder of East India ships, to prevent the loss of the rudder in case of its being unshipt.

OAKUM. Old rope, untwisted and loosened like hemp, in order to be used in caulking.

OBTUSE, BLUNT, or DULL; in opposition to acute or sharp. As an *obtuse angle*, which is said to be without a square or right angle. Such angles are called by shipwrights *standing bevellings*. *(See* Bevellings.)

ORLOP. A temporary deck below the lower deck of large ships, chiefly for the convenience of stowing away the cables. There is also a platform in the midships of smaller ships, called the orlop, and for the same purpose.

OVER-HANGING. Projecting over; as over the stern, &c.

To OVER-LAUNCH. To run the butt of one plank to a certain distance beyond the next butt above or beneath it, in order to make stronger work.

OUT-BOARD. On the outside of the ship, as "the *out-board works*," &c.

OUT-SQUARE. Any obtuse angle or standing bevelling is said to be "*out-square.*" This term is however mostly applied to knee-timber, when the angle the arms make is greater than 45 degrees. *(See Knee-Timber.)*

OUT OF WINDING. Not twisting; as the surface of a timber or plank, when it is a direct plane.

PALLETING. A slight platform, made above the bottom of the magazine, to keep the powder from moisture.

PALLS. Stout pieces of iron, so placed near a capstan or windlass as to prevent a recoil, which would overpower the men at the bars when heaving.

PANEL. A square or pane of thin board, framed in a thicker one, called a stile, and generally composed of two or more joined together. Such are the partitions by which the officers' cabins are formed on the lower deck; and such likewise are the framings of the great cabin bulkheads, &c, which consist of rails, stiles, and panels.

PARTNERS. Those pieces of thick plank, &c. fitted into a rabbet in the mast or capstan carlings for the purpose of wedging the mast and steadying the capstan. Also any plank that is thick, or above the rest of the deck, for the purpose of steadying whatever passes through the deck, as the pumps, bowsprits, &c. *(See Inboard Works, and Plans, Plates III. and IV.)*

To PAY. To lay on a coat of tar, &c. with a mop or brush, in order to preserve the wood and keep out water, when one or more pieces are scarphed together, as the beams, &c. the inside of the scarphs are paid with tar as a preservative; and the seams after they are caulked are fayed with pitch to keep the water from the oakum, &c.

PEDESTAL RAIL. A rail, about two inches thick, that is wrought over the foot-space rail, and in which there is a groove to steady the heels of the balusters of the galleries. *(See Stern, Plate I.)*

PILASTERS. Flat columns or ornaments, prepared by the joiners, generally of deal, fluted or reeded, with moulded caps and bases, which are placed upon the munions of the ward-room lights, &c. for the purpose of ornamenting the stern and quarter-galleries, particularly when the walk or balcony does not project aft. They are likewise used on the munions of the bulkheads of captain's cabin and offices.

PILLARS. The square or turned pieces of timber erected perpendicularly under the middle of the beams for the support of the decks. *(See Midship Sections, Plate III.)*

PINNACE. *(See* BOATS.)

PINS. Short iron rods fixed occasionally in the drumheads of capstans, and through the ends of the bars, to prevent their unshipping. They are confined near their respective places by a chain. Others of a larger size, are driven through the bitts to belay ropes to; and smaller ones are fixed in racks in different parts of the ship to belay the rigging to. The upright parts of the bitts are also commonly called bitt-pins.

PINK. A ship with a very narrow round stern; whence all vessels, however small, having their sterns fashioned in this manner, are said to be *pink-sterned.*

PINS AND PLATES. Pins of iron occasionally drawn out to support the palls of the capstan, and fitted in plates.

PINS OF BOATS. Pins of iron or wood, fixed along the gunwales of some boats, (instead of rowlocks,) whose oars are confined by grommets.

PINTLES. Straps of mixt metal or of iron, fastened on the rudder, in the same manner as the braces on the stern-post, having a stout pin or hook at the ends, with the points downwards to enter in and rest upon the braces on which the rudder traverses or turns, as upon hinges, from side to side. Sometimes one or two are shorter than the rest, and work in a socket brace, whereby the rudder turns easier. The latter are called *Dumb Pintles*. Some are bushed, and others burred. *(See Sheer Draught, Plate II.)*

PITCH. Tar, boiled to a harder and more tenacious substance.

PITCHING. The inclination or vibration of the ship lengthwise about her centre of gravity; or the motion by which she plunges her head and after part alternately into the hollow of the sea. This is a very dangerous motion, and, when considerable, not only retards the ship's way, but endangers the masts and strains the vessel.

PLAN. The area or imaginary surface defined by or within any described lines. In ship-building, the *Plan of Elevation*, commonly called the SHEER DRAUGHT, is a side-plan of the ship, defined by a surface limited by the head afore, by the stern abaft, the keel below, and the upperside of the vessel above. The *Horizontal Plan*, commonly called the HALF BREADTH PLAN, comprehends all the lines describing the greatest breadth and length of the ship at different heights or sections. This is named half-breadth plan, because both sides of the ship being exactly alike, only one-half is represented. To the foregoing must be added, the *Plan of Projection*, commonly called the BODY PLAN, which exhibits the outline of the principal timbers, and the greatest heights and breadths of the same. *(See the several Plans in Plate I., and Plans of the Decks, Plates III. and IV.)*

THE PLAN OF THE TRANSOMS, is the horizontal appearance of them, to which the moulds are made, and the bevellings taken.

PLANK. A general name for all timber, excepting fir, which is from one inch and a half to four inches thick. Of less dimensions it is called *board*.

PLANKING. Covering the outside of the timbers with plank; sometimes quaintly called *skinning*, the plank being the outer coating, when the vessel is not sheathed. *(See Planking, Plate III.)*

PLANK-SHEERS, or PLANK-SHEER. The pieces of plank laid horizontally over the timber-heads of the quarter-deck, forecastle, and round-house, for the purpose of covering the top of the side, hence sometimes called covering boards. *(See Sheer Draught, Plate I.)*

PLATFORMS. Are a sort of temporary or lighter kind of deck, those foreward and aft have the store-rooms and cabins on, and the platform in the midships have the cables stowed thereon.

PLUMB. Perpendicular or upright. The term originates from *plumbum*, or lead, as the perpendicular is generally ascertained by a lump of lead suspended by a cord, and generally called a *Plumb Line*.

POINT-IRON, or BRASS. A larger sort of plumb, formed conically and terminating in a point, for the more nicely adjusting any thing perpendicularly to a given line.

POINTERS or BRACES. Timbers sometimes fixed diagonally across the hold, to support the beams, &c.

POOP. The uppermost deck of a ship, abaft, commonly called the *Round House.*

POPPETS. Those pieces, mostly fir, which are fixed perpendicularly between the ship's bottom aud the bilgeways, at the fore and aftermost parts of the ship, to support her in launching. *(See Frontispiece.)*

PORT HOOKS. Iron hooks driven into the side of the ship; and to which the port-hinges are attached.

PORT-LIDS. The shutters, hung with hinges, which inclose the ports in rough weather.

PORTS. The square holes or opening in the side of the ship through which the guns are fired. *(See Sheer Draught, Plate I.)*

POST. The same with *Stern Post.*

POWDER-ROOM. A convenient apartment, built abaft in large, and forward in small ships, with racks, &c. for holding cartridges filled with powder.

PREVENTER-BOLTS. The bolts driven through the lower end of the preventer-plates to assist the chain-bolts in heavy strains. *(See Sheer Draught, Plate I., and Midship Section, Plate III.)*

PREVENTER-PLATES. Stout plates of iron, bolted through the sides at the lower part of the chains, as an additional security. *(See Sheer Draught, Plate I., and Midship Section, Plate III.)*

PRIZING. Lifting or removing a heavy body by means of a lever.

PROFILE. The draught or scheme of the inboard works, which is usually described in red lines. *(See Inboard Works, Plate IV.)*

PROJECTION, PLAN OF, or BODY PLAN. *(See* PLAN.)

PRONG. The same as Beam-Arm. *(See* BEAM-ARM.)

PROOF TIMBER. An imaginary timber, expressed by vertical lines in the sheer-draught, similar to the joints of the square timbers, and used nearly forward and aft to prove the fairness of the body. *(See Sheer Draught, Plate I.)*

PROW. A name very frequently given to the head or foremost end of a vessel, particularly by the French.

PUMP. The machine, fitted in the wells of ships, to draw water out of the hold. *(See Inboard Works, Plate IV.)*

PUMP-CISTERNS. Cisterns fixed over the heads of the pumps, to receive the water until it is conveyed through the sides of the ship by the pump-dales.

PUMP-DALES. Pipes fitted to the cisterns, to convey the water from them through the ship's sides.

QUARTER. The upper part of the topside abaft. *(See Sheer Draught, Plate I.)*

QUARTERING. Timber under five inches square.

QUARTER-DECK. That deck in ships of war which extends from the main-mast to the stern. *(See Sheer Draught, Plate I.)*

QUARTER-GALLERIES. The projections from the quarters abaft, fitted with sashes and balusters, and intended both for convenience and ornament to the aft part of the ship. *(See Sheer Draught, Plate I.)*

QUARTER-PIECES. Substantial pieces of timber, mostly of fir, that form the out-boundary of the stern, and connect the quarter-gallery to the stern and taffarel. *(See Sheer Draught and Stern, Plate I.)*

QUARTER-RAILS. Rails fixed into stantions from the stern to the gangway, and serving as a fence to prevent any one from falling overboard, &c. or birthing up the quarters. *(See Sheer Draught, Plate I.)*

To QUICKEN. To give any thing a greater curve. For instance, "*To Quicken the Sheer,*" is to shorten the radius by which the curve is struck; this term is therefore opposed to straightening the sheer.

QUICKWORK. A denomination given to the strakes which shut in between the spirkettings and clamps. *(See Midship Section, Plate III.)* By *quickwork* is also sometimes meant, all that part of a ship or vessel which is below the level of the surface of the water when she is laden.

RABBET or REBATE. A joint made by a groove, or channel, in a piece of timber cut for the purpose of receiving and securing the edge or ends of the planks, as the planks of the bottom into the keel, stem, or stern post, or the edge of one plank into another. *(See Sheer Draught, Plate I.)*

RAFT-PORT. A large square hole framed and cut through the buttock between the transoms, or forward in the bore, between the breast-hooks, and through which masts, planks, deals, &c. are taken into store-ships, or merchant-ships, carrying such cargoes which, owing to their great length, cannot be gotten on board in any other way.

RAG-BOLT. A sort of bolt having its point jagged or barbed to make it hold the more securely.

RAILS. The long narrow pieces of fir or oak, with mouldings struck on them, which are fastened or sometimes wrought from the solid plank, as ornaments to the ship's sides, and also at the head and stern. The principal are as follow; the lower rail on the side, named the *waist-rail;* and the next above it, the *sheer-rail,* which are generally placed well with the sheer or top timber line, the rails next above the sheer-rail are called *drift-rails,* and the rails above the plank-sheer the *fife-rails.* The rails of the head are distinguished by the *lower, middle, main,* and *upper rails;* and the rails of the stern take their names from the parts where they are fixed, as tuck-rail, lower counter-rail, upper counter-rail, taffarel-rail, and taffarel-fife-rail. *(See Sheer Draught, Plate I.)* To these may be added, the thwartship pieces of the framing of the great cabin bulkheads, &c.

RAKE. The overhanging of the stem or stern beyond a perpendicular with the keel, or any part or thing that forms an obtuse angle with the horizon.

RAKING-KNEES. *(See* KNEE-TIMBER.)

RAM-LINE. A small rope or line sometimes used for the purpose of forming the sheer or hang of the deck, for setting the beams fair, &c.

RANGES. Horned pieces of oak, like belaying cleats, but much larger, bolted to the inside of the ship, in the waist, for belaying the tacks and sheets. Also those pieces of oak plank fixed between the ports, with semi-circular holes in them for keeping shot in.

RASING. The act of marking by a mould on a piece of timber; or any marks made by a tool called a *rasing-knife.*

RATE. The denomination of the different classes of ships, according to their number of guns. Thus those of 100 guns and all above, are called *first rates;* those of 98 and 90 guns, *second rates;* from 80 to 64 guns, *third rates;* from 60 to 50 guns, *fourth rates;* from 40 to 32 are *fifth rates;* and all under are *sixth rates;* excepting yachts, fire ships, and hospital ships, which are ratèd as fifth rates.

RAVE-HOOK. A hooked tool used by square-makers, to haul out the small chips when enlarging the butts for receiving a sufficient quantity of oakum.

RECONCILER or RECONCILING SWEEP. A curve which reconciles the floor and lower-breadth sweeps together, and thus the shape of the body is formed below the breadth. (*See* FRAMES.)

To RECONCILE. To make one piece of work answer fair with the moulding or shape of the adjoining piece, and, more particularly, in the reversion of curves.

REEMING. A term used by caulkers for opening the seams of the planks, that the oakum may be more readily admitted.

REEMING-IRONS. The large irons used by caulkers in opening the seams.

To RELIEVE. To make a sett near to another that cannot be sett on any more till it is taken in on each side. (*See* SETT.)

RENDS. Large open splits or shakes in timber, particularly in plank, occasioned by its being exposed to the wind and sun, &c.

RESISTANCE, or RESISTING FORCE. (*Preceding Chapters.*)

RHODINGS OF THE PUMPS, &c. The brass cleats on which the axles work.

RIBBAND-LINES. The same with diagonal lines.

RIBBANDS. The longitudinal pieces of fir, about five inches square, nailed to the timbers of the square body (those of the same description in the cant body being shaped by a mould and called *Harpins*) to keep the body of the ship together, and in its proper shape, until the plank is brought on. The shores are placed beneath them. They are removed entirely when the planking comes on. The difference between *Cant Ribbands* and *Square* or *Horizontal Ribbands* is that the latter are only ideal, and used in laying off.

RIBS. A figurative expression for the timbers or frames of a ship, arising from the comparison of it with the human body, as the keel with its kelson to the back bone, and the timbers to the ribs. For the former unite and support the whole fabric, since the stem and stern frame, which are elevated on the ends of the keel, may be said to be a continuation of it, and serve to connect and inclose the extremities, by the hawse pieces and transoms, as the keel forms and unites the bottom by the floor-timbers. The idea carried further may in a manner represent the muscular parts of the human fabric; for the wales, clumps, and thick-stuffs, at the different heads of the timbers, are as so many muscles or strong ligaments to connect the ribs together, while the thinner planking may be compared to the skin or covering of the whole, and hence planking is often termed *skinning.* (*See Midship Section, Plate III.*)

RIDERS. Interior ribs to strengthen and bind the parts of a ship together, being fayed upon the inside stuff, and bolted through all. They are mostly used in ships of war, and are variously situated, as the *Floor Riders,* which are fayed athwart the kelson, and should be disposed upon the first futtocks of the ship. The next are the lower or *first futtock riders,* which fay alongside the floor-riders, and give scarph above them. These are completed by cross-chocks athwart their heels, that scarph to each side with hook and butt. The next are *second futtock riders,* which fay alongside of the first futtock riders, down to the floor riders, and run up to the orlop beams. The *third futtock riders* fay alongside the second futtock riders, scarph or meet the first futtock riders, and run up to the gun-deck beams. The whole are bolted together fore and aft-wise. The riders next above the foregoing are called *breadth riders,* and are placed nearly in the broadest part of the ship (hence their name,) and diagonally so as to partake of two or more timbers, the strength depending much thereon. Lastly, the *top-riders* are the uppermost; they stand nearly the same as breadth riders, and very much strengthen the topside. Riders are not so much required in merchant ships as in ships of war, excepting floor and lower riders, (which are generally of iron,) because, in merchant ships the cargo being generally stowed low down, the upper works are not liable to strain and labour like those of ships of war laden high up with heavy metal.

RIMS. Those pieces which form the quarter galleries between the stools. *(See Sheer Draught, Plate I.)* Also a cast iron frame in which the dropping palls of a capstan traverse and bring up the capstan.

RING-BOLTS. *(See* BOLTS.)

RINGS. Circles of iron, or other metal, for lifting things by hand or securing the points of bolts, &c. *Hatch Rings* are those which are fixed to the hatches or scuttles, to open or shut them with. *Port Rings* are those which are fixed to the port or scuttle lids to haul them open by, or bar them in.

RISING. A term derived from the shape of a ship's bottom in general, which gradually narrows, or becomes sharper towards the stem and the stern post. On this account, the floor, towards the extremities of the ship, is raised or lifted above the keel: otherwise the shape would be so very acute, as not to be provided from timber with sufficient strength in the middle or cutting-down. The floor timbers forward and abaft, with regard to their general form and arrangement, are therefore gradually lifted or raised upon the solid body of wood called the *dead* or *rising-wood,* which must, of course, have more or less rising as the body of the ship assumes more or less fullness or capacity. *(See* DEAD RISING.)

THE RISINGS OF BOATS is a narrow strake of board fastened withinside to support the thwarts.

RISING HALF-BREADTH, or NARROWING OF THE FLOOR-SWEEP. A curve line, on the half-breadth plan, which determines the distance of the radius of the floor-sweeps from the middle line. *(See Sheer Draught, Plate I.)*

RISING FLOORS. The floors forward and abaft, which, on account of the rising of the body, are the most difficult to be obtained, as they must be deeper in the throat or at the cutting down, to preserve strength.

RISING-LINE. An elliptical line, drawn on the plan of elevation, to determine the sweep of the floor-heads throughout the ship's length, which accordingly ascertains the shape of the bottom with regard to its being full or sharp. *(See Sheer Draught, Plate I.)*

RISING-SQUARE. A square used in whole moulding, upon which is marked the height of the rising-line above the upper edge of the keel. *(See Long Boat, on Plate IV.)*

RISING STRAIGHT, in whole moulding, is a curve line in the sheer plan, drawn at the intersection of the straight part of the bend mould, when continued to the middle line at each respective timber. *(See Long Boat, on Plate IV.)*

RISING-WOOD. *(See* DEAD WOOD.)

ROLLERS. Cylindrical pieces of timber revolving on an axis, and so fixed above the deck, either horizontally or perpendicularly, as to prevent the chafing of the cable or hawser, &c. against the jear and top-sail sheet bitts, &c. Those placed forward in the manger are for the use of the voyal or messenger.

ROLLING. That motion by which a ship vibrates from side to side. Rolling is therefore a sort of revolution about an imaginary axis passing through the centre of gravity of the ship: so that the nearer the centre of gravity is to the keel, the more violent will be the roll, because the centre, about which the vibrations are made, is placed so low in the bottom, that the resistance made by the keel to the volume of water which it displaces in rolling, bears very little proportion to the force of the vibration above the centre of gravity, the radius of which extends as high as the mast-heads. But, if the centre of gravity is placed higher above the keel, the radius of the vibration will not only be diminished, but such an additional force to oppose the motion of rolling will be communicated to that part of the ship's bottom as may contribute to diminish this movement considerably.

It may be observed that, with respect to the formation of a ship's body, that shape which approaches nearest to a circle is the most liable to roll; as it is evident, that if this be agitated in the water, it will have nothing to restrain it; because the rolling or rotation about its centre displaces no more water than when it remains upright, and hence it becomes necessary to increase the depth of the keel, the rising of the floors, and the deadwood afore and abaft.

ROOMS. The different vacancies between the timbers, and likewise those between the beams, as the MAST-ROOMS, CAPSTAN-ROOM, HATCH-ROOM, &c. Also the different apartments or places of reserve, of which there are a number in a ship, as the *Bread-Room*, an apartment in the hold abaft for containing the bread for the ship's use. The *Fish-Room*, an apartment next adjoining, in which cured or dried fish was formerly stored, but which is now generally used as a coal-hole, and to stow spirits in. The *Captain's* and *Lieutenant's Store-Rooms*, are two apartments built near each other on the starboard side of the after platform, for those officers to store their wine in, &c. *Sail-Rooms* are built between decks upon the orlop or lower deck to contain the spare sails. The *Spirit-Room* is built in the hold, next before the fish-room, to contain the spiritous liquors for the use of the ship's company. Besides these, there are several other store-rooms in which the carpenter's, boatswain's, and gunner's stores are kept; with the *Steward's-Room*, whence most of the provisions are issued, and which is the place appointed for the purser's steward to transact his business in.

The *Filling Room* is a place parted off and lined with lead in the magazine, wherein the powder is started, in order to fill the cartridges.

ROOM AND SPACE. The distance from the moulding edge of one timber to the moulding edge of the next timber, which is always equal to the breadth of two timbers, and two to four inches or more. The room and space of all ships that have ports should be so disposed that the scantling of the timber on each side of the lower ports, and the size of the ports fore and aft, may be equal to the distance of two rooms and space. *(See Sheer Draught, Plate I.)*

ROUGH-TREE-RAILS. Rails along the waist and quarters, nearly breast-high, to prevent persons from falling overboard. This term originated from the practice in merchant vessels of carrying their rough or spare-gear in crutch-irons along their waist. *(See Sheer Draught, Plate I.)*

ROUND-AFT. The segment of a circle that the stern partakes of from the wing-transom upward.

ROUND-HOUSE. That part of the ship abaft, which is above the quarter-deck, fitted up with cabins, &c. for the accommodation of the officers. *(See Sheer Draught, Plate I.)*

ROUND-HOUSES AT THE HEAD. Conveniencies or seats of ease for the officers. *(See Half Breadth Plan, Plate I.)*

ROUND STERN. The stern of a vessel whose bottom, wales, &c. are wrought quite aft, and unite in the stern-post. Few English vessels are built on this construction, excepting small vessels, as hoys, &c. (*See* SQUARE STERNED.)

ROWLOCKS. The scores in the sides of boats wherein the oars or sculls are confined to row them with.

ROW PORTS. Square scuttles cut through the sides of frigates, sloops, and small vessels, one between each port in midships, through which the sweeps are worked to row them along in a calm or light wind. In point of utility they are therefore similar to rowlocks along the gunwale of boats.

ROUND-UP OF THE TRANSOMS. The segment of a circle to which they are sided, or of beams to which they are moulded.

RUDDER, or ROTHER. The machine, attached to the stern post, by the pintles and braces, which serve to direct the course of the ship. It is formed of several pieces of timber, of which the main piece is generally of oak, extends the whole length, and forms the head. The bearding piece, which forms the fore part, is of elm, and derives its name from its shape, because from the middle, each way, it is shaped anglewise, or bearded to two-fifths of its thickness, or less if the stern-post is bearded back, that the rudder occasionally may form an obtuse angle with the ship's length. The other pieces are of fir. *(See Sheer Draught, Plate I.)*

RUDDER-CHOCKS. Large pieces of fir, to fay or fill up the excavation on the side of the rudder hole; so that the helm being in midships the rudder may be fixed, and supposing the tiller broken, another might thus be supplied.

RUDDER-IRONS. A name by which the pintles are frequently called. (*See* PINTLES.)

RUDDER PENDANTS. Ropes to prevent the loss of the rudder in case of its being unshipped by accident.

RUN. The narrowing of the ship abaft, as of the floor towards the stern-post, when it becomes no broader than the post itself.

This term is also used to signify the running or drawing of a line on the ship, or mould loft floor, as "to *run* the wale line," or deck line, &c.

SADDLE. A piece sometimes fayed upon the upper end of the lacing to secure the foremost ends of the main rails.

SAGGING. (*See* HOGGING.) In seamanship, SAGGING *to leeward*, signifies the movement by which a ship makes considerable leeway, or is driven far to leeward of the course on which she apparently sails. But as a phrase applied to the hull of the ship is the very reverse of HOGGING, as then the midship part of the ship by straining arches upwards, whereas in sagging, by a different sort of strain, it curves downwards.

SAILS. The surfaces of canvas, extended on or between the masts, to receive the force of the wind, and thereby press the vessel through the water.

SAIL-ROOM. (*See* ROOMS.)

SAMPSON'S POST. A large pillar or stantion placed up diagonally on each side against the quarter-deck beam, and next afore the cabin bulkhead, with its lower end tenoned into a chase on the upper deck. It is used to bring the fish-tackle too when fishing the anchor, &c. This name is also given to the pillar immediately under the hatchways, having scores on each side, as steps, to go up and down by. This pillar is of so much larger scantling than the other pillars, as not to be too much weakened by the scores.

SAWS. The most useful instruments used in carpentry. The *hand-saw* is the smallest, and is used by one hand. The *two-hand* or *cross-cut-saw* is much longer, and is used by two men. The *whip-saw* is the longest of all, being that generally used in a saw-pit, or for the more laborious purposes. The *hack-saw* is made of a scythe jagged at the edge, and used chiefly for cutting off iron bolts.

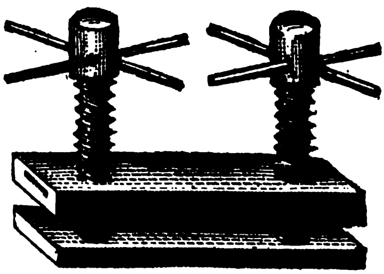
SCALE. The graduated lines, divided into equal parts, and placed at the bottom of the sheer draught, &c. as a common measure for ascertaining the dimensions by the plan; and for this purpose each of the larger divisions represents a foot, and the subdivisions, inches. (*See Sheer Draught, Plate I.*)

SCANTLING. The dimensions given for the timbers, plank, &c. Likewise, all quartering under five inches square, which is termed scantling; all above that size is called CARLING.

SCARPHING. The letting of one piece of timber or plank into another with a lap, in such a manner, that both may appear as one solid and even surface, as keel-pieces, stem pieces, clamps, &c.

SCHOONER. A cutter-built vessel, but longer in proportion than a cutter, and having two masts, whose main-sail and fore-sail are spread upon a gaff or boom.

SCREEN BULKHEAD. The after bulkhead under the round-house.



SCREWS, BED or BARREL. A powerful machine for lifting large bodies; and when placed against the gripe of a ship, to be launched for starting her. It consists of two large poppets or male screws, having holes through their heads to admit levers, a bed formed by a large oblong piece of elm, with a female screw near each end to admit the poppets, and a sole of elm plank for the heels of the poppets to work on, agreeably to the annexed figure. Those used as last described, have an inclined sole so as to stand square to the stem or knee.

SCREWS, HAND. (*See* HAND SCREWS.)

SCROLL. A spinal ornament fastened at the drifts. (*See* DRIFTS.) Likewise the finish of the upper part of the hair bracket. (*See Sheer Draught, Plate I.*) For SCROLL HEAD. (*See* HEAD.)

SCUPPERS. Leaden pipes let through the ship's side to convey the water from the decks.

SCUTTLES. Square openings cut through the decks, much less than the hatchways, for the purpose of handing small things up from deck to deck. There are also scuttles cut through the sides of the ship, some for the admission of air and light into the cabins between decks, and some between the ports, through which the sweeps are used, to row the ship along in calms, and one is cut in each port-lid of two-deck ships to admit air and light between decks.

SEA-BOAT. A vessel that bears the sea firmly, without straining her masts, &c. is commonly said to be "a good *sea-boat*."

SEAMS. The openings between the edges of the planks when wrought.

SEASONING. A term applied to a ship kept standing a certain time after she is completely framed and dubbed out for planking, which should never be less than six months when circumstances will permit. *Seasoned plank* or *timber* is such as has been cut down and sawn out one season at least, particularly when thoroughly dry, and not liable to shrink.

SEAT. The scarph or part trimmed out for a chock, &c. to fay to.

SEATING. That part of the floor which fays on the deadwood; and of a transom which fays against the post.

SEAT TRANSOM. That transom which is fayed and bolted to the counter-timbers, next above the deck transom, at the height of the port sills.

SECTION. A draught or figure, representing the internal parts of the ship, at any particular place athwartships. (*See Midship Section, Plate III.*)

SETTING, or SETTING-TO. The act of making the planks, &c. fay close to the timbers, by driving wedges between the planks, &c. and a wrain-staff. Hence we say, "Set, or set away," meaning to exert more strength. The power or engine used for the purpose of setting is called a

SETT, and is composed of two ring-bolts, and a wrain-staff, cleats, and lashings.

SHACKLES. The small ring-bolts driven into the ports, or scuttles, and through which the lashing passes when the ports are barred in.

SHAKEN, or SHAKEY. A natural defect in plank or timber when it is full of splits or clefts, and will not bear fastening or caulking.

SHANK-PAINTER. A chain bolted through the topside, abaft the cathead, to retain the shank and flukes of the anchor when stowed.

SHEATHING. A thin sort of doubling, or casing, of fir-board or sheet copper, and sometimes of both, over the ship's bottom, to protect the planks from worms, &c. Tar and hair, or brown paper dipt in tar and oil, is laid between the sheathing and the bottom.

SHEAVE. A cylindrical wheel made of hard wood, moveable round a rim as its axis, and placed in a block, of which there are several in the sides of a ship, let through the side and chest-trees, for assisting to lead the tacks and sheets on board, &c.

SHELL-ROOMS. A compartment in a bomb-vessel, fitted up with shelves to receive bomb-shells when charged.

SHEER. The longitudinal curve or hanging of the ship's side in a fore and aft direction. *(See Sheer Draught, Plate I.)*

SHEER DRAUGHT. The plan of elevation of a ship, whereon are described the outboard works, as the wales, sheer-rails, ports, drifts, head, quarters, post and stem, &c. the hang of each deck inside, the height of the water-lines, &c. *(See Sheer Draught, Plate I.)*

SHEER-RAILS. The narrow ornamental mouldings along the topside, which are parallel to the sheer. They are generally made of deal but are sometimes wrought from the solid plank. *(See Sheer Draught, Plate I.)*

SHEER-STRAKE. The strake or strakes wrought in the topside, of which the upper edge is wrought well with the top-timber line, or top of the side, and the lower edge kept well with the upper part of the upper deck ports in midships, so as to be continued whole all fore and aft, and not cut by the ports. It forms the chief strength of the upper part of the topside, and is therefore always worked thicker than the other strakes, and scarphed with hook and butt between the drifts. *(See Sheer Draught, Plate I.)*

SHEER-WALES, or MIDDLE-WALES. Those strakes of thick stuff in the topside of three-decked ships which are wrought between the middle and lower deck ports.

SHEERS. Two rough masts erected across the building slip, for hoisting the ship's frames, &c. They are lashed together at their upper ends, with tackles depending from the intersection at top; and are kept upright by guys extending forward and aft from the heads. The heels are lashed to prevent their spreading.

That some judgment may be formed of the dimensions of sheers, we subjoin the following, which are sufficient for raising the stern-frame of the largest ship in the English navy. Two masts, each nineteen inches and a half in diameter, and sixty-six feet long, spread at the heels, from out to outside, forty-six feet four inches. The tackles, consisting of four treble blocks, twenty-eight inches long, the sheaves brass coaked. The falls new eight-inch rope. One treble block lashed, so as to be fixed to the aft part of the sheers, and another to the foreside. Shivers to stand nearly athwartships, and fair with the leading-block at the heels of the sheers, to prevent the fall from rubbing against the cheeks of the blocks. One treble block lashed to the back of the stern frame, between the deck and filling transoms, to stand athwartships, and lead to the opposite sheer. To have a double tackle at the head of the stern-post, the fall 3½ inch rope, to bowse the head forward occasionally, with a double tackle at the heel of 4½ inch rope, to ease it forward or bowse it aft as required. One double tackle at each end of the wing transom, called horning tackles, to lead to the standards most convenient to horn or square the frame as wanted. The after treble block at the sheer head is to plumb the after part of the wing transom as nearly as possible, and the guys to steady the sheer-heads, two to lead forward and two aft on each side of the slip, to be seven inch hawsers.

SHIFT. A term applied to disposing the butts of the planks, &c. so that they may over launch each other without reducing the length, and so as to gain the most strength. The planks of the bottom, in British-built ships of war, have a six-feet shift with three planks between each butt, so that the planks run twenty-four feet long. In the bottoms of merchant ships they have a six-feet shift with only two planks between each butt; making but eighteen-feet planks in length. The shift of the timbers are more or less according to the contract. *(See Disposition of the Frame, and Planking expanded, Plate III.)*

SHIFTING. The act of setting off the length of the planks of the bottom, topside, &c. that the butts may over-run each other, in order to make a good shift. *(See Planking, Plate III.)* Replacing old stuff with new is also called *shifting*.

SHOLES. Pieces of oak or plank, placed under the soles of the standards; or under the heels of the shores, in docks or slips where there are no groundways, to enable them to sustain the weight required without sinking. Old hanging port-lids are particularly suitable and useful for this purpose.

SHORES. Those pieces of timber fixed under the ribbands, or against the sides and bottom of the ship to prop her up whilst building.

SHOT-LOCKERS, or GARLANDS. Apartments built up in the hold to contain the shot. Also pieces of oak plank, fixed against the head-ledges and coamings of the hatch and ladderways, or against the side between the ports to contain the shot; for which purpose they are hollowed out to near one-third of its diameter, so that the balls lie in them about one inch asunder. It is the latter that are termed garlands.

SHRINKING. The contraction or loss of substance in timber as it gets dry.

SHROUDS. The range of large ropes extended from each side of the ship to the mast-heads for the support of the masts.

SIDE COUNTER TIMBER. The stern timber which partakes of the shape of the topside and heels upon the end of the wing transom. *(See Disposition, Plate III.)*

SIDING, or SIDED. The size or dimensions of timber the contrary way to the moulding, or mould side.

SILLS, or CELLS. The pieces of plank, or timber, let in horizon-

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tally between the frames to form the lower and upper sides of the ports, and between the timbers for scuttles, &c.

SIRMARKS. The different places marked upon the moulds where the respective bevellings are to be applied, as the lower sirmark, floor sirmark, &c.

SKEG. The after part of the keel, or that part whereon the stern-post is fixed.

SKEG-SHORES. One or two-pieces of four-inch plank, put up endways under the skeg of the ship, to steady the after part a little when in the act of launching. They are confined to the bottom of the ship by a hinge. The upper part is rounded, and they should be so carefully fixed as to fall readily when the ship starts; for the writer hereof once saw a seventy-four-gun ship detained from launching by her skeg-shore only.

SKIDS. Pieces of oak plank, formed to the topside of the ship, and extending vertically from the wales to the top of the side. Their use is, to preserve the ship's side from being injured by weighty bodies, when hoisted into or lowered out of the ship, but as they are seldom wanted, for the reason heretofore given under the article FENDERS, their tendency to conduce to the decay of the sides ought to explode them.

SKINNING. A term often used for planking. (*See* RIBS.)

SLEEPERS. Pieces of compass timber fayed and bolted upon the transoms and timbers adjoining, withinside, to strengthen the buttock of the ship.

SLICES. Tapering pieces of plank, used to drive under the false keel, and settle the ship upon.

SLIDING-KEELS. An invention of the ingenious Captain Schank, of the Royal Navy, to prevent vessels from being driven to leeward by a side wind. They are composed of plank of various breadths, erected vertically, so as to slide up and down, through the keel.

SLIDING PLANKS, are the planks upon which the bilgeways slide in launching.

SLIP. The foundation laid for the purpose of building the ship upon, and launching her.

SLOOP. According to the general acceptation of the word, a small merchant or coasting vessel with one mast. But all ships of the Royal Navy carrying less than twenty guns, and being above the class of gun-vessels, are denominated sloops, excepting bomb-vessels and fire-ships.

SLOP-ROOM. The place appointed for the purser to keep the ship's slops in. (*See* ROOMS.)

To SNAPE. To hance or bevel the end of any thing so as to fay upon an inclined plane.

SNOW. A vessel similar in construction to a brig, but the largest of vessels fitted with two masts. It has a square foresail and mainsail, with a trysail abaft, resembling the mizen of a ship, and hoisted by a gaff upon a small mast, close abaft the main-mast, which is called the trysail mast.

SNYING. A term applied to planks when their edges round or curve upwards. The great sny occasioned in full bows or buttocks is only to be prevented by introducing steelers. (*See* STEELER.)

SOLE. A sort of lining to prevent wearing or tearing away the main part to which it may be attached; as the rudder, bilgeways, &c. (*See Sheer Draught, Plate I.*)

SPALING. Keeping the frames of a ship to their proper breadths by the cross-spales, which should so remain till some of the deck knees are bolted. (*See* CROSS SPALES.)

SPANSHACKLE. A large bolt driven through the forecastle and upper deck beams, and forelocked under each beam. It has a large square ring at the head, for the purpose of receiving the end of the davit. It has however been long since disused in the Royal Navy, as the davits are more commodiously fixed in the fore-channels.

SPARS. Small firs used in making staging.

SPILES. Small wooden pins, which are driven into nail-holes, to prevent leaking, &c.

SPILINGS. The dimensions taken from a straight line, a mould's edge, or rule-staff, to any given line or edge.

SPIRIT ROOM. A place built abaft the after-hold to contain the spirits. (*See* ROOMS.)

SPIRKITTING. A thick strake, or strakes, wrought within side upon the ends of the beams or waterways. In ships that have ports the spirkitting reaches from the waterways to the upperside of the lower sill, which is generally of two strakes, wrought anchor-stock fashion; in this case, the planks should always be such as will work as broad as possible, admitting the butts be about six inches broad. (*See Midship Section, Plate III.*)

SPLA-BOARDS. Boards or plank fixed to an obtuse angle, to throw the light into the filling room of a magazine.

SPRUNG. A term indicating that a plank, &c. is strained so much in the working as to crack or fly open, and so as to be nearly broken off. To SPRING, is to quicken or raise the sheer.

SPURN WATER. A channel left above the ends of a deck to prevent water from coming any further.

SPURS. Large pieces of timber, the lower ends of which are fixed to the bilgeways, and the upper ends fayed and bolted to the ship's bottom. They are used in some of the Royal Yards, although not by merchant builders, as an additional security to the bilgeways in case any other part should fail in launching the ship.

SPURS OF THE BEAMS, or BEAM-ARM. (*See* BEAM-ARM.)

A SQUARE. An instrument formed by a stock and a tongue, fixed at right angles. To SQUARE is to horn or form with right angles; and to STAND-SQUARE is to stand or be at right angles relatively to some object.

SQUARE BODY. The figure which comprehends all the timbers whose areas or planes are perpendicular to the keel, which is all that portion of a ship between the cant-bodies. (*See* BODIES.)

A SQUARE MAKER. A shipwright who cuts the butts to receive the oakum, and prepares the work ready for the caulkers.

SQUARE RIBBANDS. The same as horizontal ribbands. (*See* RIBBANDS.)

SQUARE-STERNED. A term applied to ships whose wing-transom is at right angles, or nearly at right angles, with the stern-post, and towards the upper side of which the upper planks of the bottom butt, or finish, in a rabbet formed by the tuck-rail; the other part of the plank stopping at the side counter timbers, by which means the stern may be commodiously fitted with sashes, walks, &c. All British ships are now built upon this principle, whilst many of other nations are still constructed by the ancient methods; hence we so frequently hear the phrase of "square-sterned and British built," as our practice in this respect justly claims the superiority over that of all other nations.

SQUARE TIMBERS. The timbers which stand square with, or perpendicular to, the keel. (*See* SQUARE BODY.)

SQUARE TUCK. A name given to the after part of a ship's bottom when terminated in the same direction up and down as the wing-transom, and the planks of the bottom end in a rabbet at the foreside of the fashion piece; whereas ships with a buttock are round or circular, and the planks of the bottom end upon the wing-transom.

STABILITY. That quality which enables a ship to keep herself steadily in the water, without rolling or pitching. Stability in the construction of a ship, is only to be acquired, by fixing the centre of gravity at a certain distance below the meta-centre, because the stability of the vessel increases with the altitude of the meta-centre above the centre of gravity. But when the meta-centre coincides with the centre of gravity, the vessel has no tendency whatever to remove out of the situation into which it may be put. Thus if the vessel be inclined either to the starboard or larboard side, it will remain in that position till a new force is impressed upon it; in this case, therefore, the vessel would not be able to carry sail, and is consequently unfit for the purposes of navigation. If the meta-centre falls below the common centre of gravity, the vessel will immediately overset.

As the meta-centre, or its determination, is of the utmost importance in the construction of ships, the student who wishes to make himself more particularly acquainted therewith, may see the subject more fully illustrated in the "*Elements and Practice of Naval Architecture.*"

STAGES. The platforms on which the shipwrights work.

STANDARDS. Large knees, of oak or iron, fayed on the deck and against the side. The arm upon the deck is bolted through the beams and clenched beneath, and the other arm through the ship's side. Their use is, for strengthening the sides, and resisting any violent or sudden shock. (*See Midship Section, Plate III.*)

There is also a standard fayed on the gun-deck against the apron forward, another against the transoms abaft, and one in the head upon the knee, when the piece against the stem does not run high enough for the hole of the main-stay collar.

STANDARDS are also large poles, set up endways at certain distances round the slips, and to which the spars are hung to support the staying. They have cleats nailed along the fore and after sides, at about two feet distance, in nearly the whole length.

STANDING. A term applied to a bevelling which is obtuse, or without a square, to distinguish it from an acute or under bevelling, which is within a square.

STANTIONS or STANTIENTS. The upright pieces of quartering in a bulkhead, breastwork, &c. Likewise the iron uprights, fixed round the quarters for the netting, and along the waist, to ship the rail in, &c.

STAPLES. Crooked fastenings. KEEL-STAPLES are generally made of copper, from six to twelve inches long, with a jagged hook at each end. They are driven into the sides of the main and false keels to fasten them.

STARBOARD-SIDE. The right hand side of the ship when looking forward from the stern.

STAYS. Large ropes to support the masts which are extended towards the forepart of the ship counteracting the effort of the shrouds which mostly lead abaft, and thereby keeping the mast in a steady position.

STEELER. A name given to the foremost or aftermost plank, in a strake which drops short of the stem and stern-post, and of which the end or butt nearest the rabbet is worked very narrow, and well forward or aft. Their use is, to take out the snying edge occasioned by a full bow, or sudden circular buttock. *(See Planking Expanded, Plate III.)*

STEERING-WHEEL. The wheel on the quarter deck to which the tiller rope is connected; and by turning of which, the helm is moved or kept in any fixed position. *(See Inboard Works, Plate IV.)*

STEM. The main timber at the fore-part of the ship, formed, by the combination of several pieces, into a circular shape, and erected vertically to receive the ends of the bow-planks, which are united to it by means of a rabbet. Its lower end scarphs or boxes into the keel, through which the rabbet is also carried, and the bottom unites in the same manner. *(See* RIBS. *See Sheer Draught, Plate I.)*

STEMSON. A piece of compass timber, wrought on the aft part of the apron withinside, the lower end of which scarphs into the kelson. Its upper end is continued as high as the middle or upper-deck; and its use is to succour the scarphs of apron, as that does those of the stem. *(See Inboard Works, Plate IV.)*

STEPPING. A rabbet sunk in the dead-wood, at the bearding-line, whereon the heels of the timbers rest. *(See* BEARDING LINE. *See also Sheer Draught, Plate I.)*

STEPS OF THE MASTS. The steps into which the heels of the masts are fixed, are large pieces of timber. Those for the main and fore masts are fixed across the kelson, and that for the mizen mast upon the lower deck beams.

The holes or mortises into which the masts step, should have sufficient wood on each side to accord in strength with the tenon left at the heel of the mast, and the hole should be cut rather less than the tenon, as an allowance for shrinking. *(See Inboard Works, Plate IV.)*

STEP FOR THE CAPSTAN. A solid lump of oak, fixed on the beams, in which the heel of the capstan works. *(See Inboard Works, Plate IV.)*

STEPS FOR THE SHIP'S SIDE. The pieces of quartering, with mouldings, nailed to the sides, amidships, about nine inches asunder, from the wale upwards, for the convenience of persons getting on board. *(See Sheer Draught, Plate I.)*

STERN. The after part of the ship extending from the wing-transom upwards, being terminated above by the taffarel, below by the counters, and on the sides by the quarter-pieces. It therefore comprehends the lights or windows of the captain's cabin, &c. *(See Sheer Draught, Plate I.)*

STERN-FRAME. The strong frame of timber, composed of the stern-post, transom and fashion-piece, which form the basis of the whole stern.

STERN-POST. The principal piece of timber in the stern-frame, on which the rudder is hung, and to which the transoms are bolted. It therefore terminates the ship below the wing-transom, and its lower end is tenoned into the keel. *(See Sheer Draught, Plate I.)*

STEWARD'S ROOM. An apartment built on the larboard side of the after platform, whence the purser's steward issues the provisions to the ship's company, and where he makes up his accounts, &c.

STIFF. Stable or steady. (*See* STABILITY.)

STILES. The upright pieces of the framing of the great cabin bulkheads, &c. which comprehends the panels.

STIRRUP. An iron or copper plate, that turns upwards on each side of a ship's keel and dead-wood, at the fore-foot, or at her skeg, and bolts through all. This can only be necessary when the dead-wood bolts are driven short, or are supposed to be insufficient.

STIVING. The elevation of a ship's cathead or bowsprit; or the angle which either makes with the horizon. *(See Sheer Draught, Plate I.)*

STOOLS. Pieces of plank, bolted to the quarters, for the purpose of forming and erecting the galleries. *(See Sheer Draught, Plate I.)* Also ornamental blocks for the poop lanterns to stand on abaft. (*See* BACKSTAY STOOLS.)

STOPPINGS-UP. The poppets, timber, &c. used to fill up the vacancy between the upper-side of the bilgeways and the ship's bottom, for supporting her when launching. *(See Frontispiece.)*

STOPPER-BOLTS. Large ring-bolts, driven through the deck and beams before the main-hatch, for the use of the stoppers. They are carefully clinched on iron plates beneath.

STOPPERS. Short ropes, with a knot at one end, and the other end turned round a thimble into the ring of the stopper-bolts, by which, and its laniard, the cable is confined.

STORE-ROOMS. The several apartments built upon the platform to contain the different officers' stores. (*See* ROOMS.)

STRAIGHT OF BREADTH. The space before and abaft dead-flat, in which the ship is of the same uniform breadth, or of the same breadth as at ⊕ or dead-flat. (*See* DEAD FLAT.)

STRAKE. One breadth of plank wrought from one end of the ship to the other, either within or without board.

STRING. One or two strakes of plank withinside, next under the gunwale, answering to the sheer-strake withoutside, scarphed in the same manner as the sheer-strake, giving shift to the scarphs of the sheer-strake, and bolted through the ship's side into the sheer-strake between the drifts, to give greater strength; as this part requires all the security that is possible to be given in order to assist the sheer. *(See Midship Section, Plate III.)*

SUPERNATANT PART OF THE SHIP. That part which when afloat, is above the water, anciently expressed by the name of *Dead Work.*

SUPPORTERS. The circular knees placed under the catheads for their security and support. (*See Sheer Draught, Plate I.*)

SURGE. The tapered part of the whelps, between the chocks of the capstan, upon which, when judiciously hollowed, the messenger may surge itself without any other incumbrance.

SURMARKS. (*See* SIRMARKS.)

SWEEP OF THE TILLER. A semi-circular plank, fixed up under the beams near the fore-end of the tiller, which it supports.

On the foreside of the sweep is a groove for the tiller rope, in which groove rollers are fixed to enliven the rope. On the aftside is a ledge or rabbet defended with iron plate, on which the goose-neck of the tiller traverses.

SWEEPS. The various parts of the bodies shaped by segments of circles. Such are the *floor-sweeps, lower breadth-sweep, upper breadth-sweep,* and *back-sweep,* or *toptimber-hollow.* (*See* FRAME. *See also Body Plan, Plate I.*)

SYPHERED. A mode of joining, by over-lapping the edge of one plank upon another, with a bevelling edge, instead of rabbetting, in such a manner that both planks shall make a plain surface, though not a flat or square joint. (*See* HARRIS-CUT.)

TABLING. Letting one piece of timber into another by alternate scores or projections from the middle, so that it cannot be drawn asunder either lengthwise or sidewise. (*See Beams of the Lower Deck Plan, Plate IV.*)

TACKLE. An assemblage of two or more blocks connected by a rope called the fall reeved through their mortises, and used for lifting or removing weighty bodies.

TAFFAREL, or TAFF-RAIL. The upper part of the ship's stern, usually ornamented with carved work or moulding, the ends of which unite to the quarter-pieces. (*See Sheer Draught, Plate I.*)

To TAIL, or DOVE-TAIL. To let one piece of timber into another, when the lap forms a sort of wedge, so that it cannot come asunder endwise. (*See the Stern in Plate I.*)

To TAKE-IN. To come up with a set and make it fast again closer to the plank, as it works nearer to the timbers. (*See Set.*)

TAR. The juices of the pine or fir-tree boiled to a thick consistence, and used to pay the joints between scarphs of beams, &c. and also the outside of the ship; because, by filling up the pores of the wood, it prevents the sun from splitting, and the wet from rotting it.

TASKING of PLANK or TIMBER. Chipping it with an adze, or boring it with a small auger, for the purpose of ascertaining its quality or defects.

To TEACH. A term applied to the direction that any line, &c. seems to point out. Thus we say, "let the line or mould *teach fair* to such a spot, rase," &c.

TENON. The square part at the end of one piece of timber diminished so as to fix in a hole of another piece, called a mortise, for joining or fastening the two pieces together.

TERMS or TERM-PIECES. Pieces of carved work placed under each end of the taffarel, upon the side stern-timber, and reaching as low down as the foot-rail of the balcony.

THICKSTUFF. A name for sided timber, exceeding four inches, but not being more than twelve inches, in thickness.

THOLES. The battens or pins which form the rowlocks of a boat.

THROAT. The inside of knee timber at the middle or turn of the arms. Also the midship part of the floor timbers and transoms.

THWARTS. The benches in a boat whereon the rowers sit to manage their oars.

THWARTSHIPS or ATHWARTSHIPS. Across the ship, or from one side to the other. RIGHT ATHWART, signifies square, or at right angles, with the keel.

TIER. A regular row of any thing, as of carlings, of shores, of ships, &c. *(See Lower Deck Plan, Plate IV.)*

TILLER. A piece of timber (which should be straight grained and free from knots) fitted into the head of the rudder as a lever for the purpose of moving it from side to side, in order to steer the ship. *(See Inboard Works, Plate IV.)*

TIMBERS. A name generally given to the pieces of timber which compose the frame of a ship, *(See Plate III.)*, as floor-timbers, futtock-timbers, and toptimbers *(See Midship Section, Plate III.)*; as also the stem or head-timbers, and the stern-timbers. *(See Sheer Draught, Plate I.)* Sometimes those carved ornaments upon the munions, in the stead of pilasters, are called stern-timbers.

TIMBER AND ROOM, or ROOM AND SPACE. *(See the latter.)*

TONGUE. A long tapered end of one piece of timber made to fay into a scarph at the end of another piece. This method is used to gain length, and is called tongueing. *(See Tonguing.)*

TONGUE OF A BEVEL. The moveable part by which the angles or bevellings are taken.

CALVES TONGUE is a sort of moulding usually made at the caps and bases of turned or round pillars to taper or hance the round part to the square.

TONGUING, is lengthening the main-piece of timber by another piece generally shorter. The one piece is fitted into the other by a long tapering tenon or tongue, and both are bolted and sometimes hooped together.

TONNAGE. The cubical content, or burthen of a ship in tons; which is commonly estimated by a fantastical rule, given hereafter, producing what is denominated the builder's tonnage. The real burthen a ship is to carry, when brought down in the water to the load draught of water intended in the construction, may be found by the rules given in the subsequent part of this work.

The word is derived from a ton, or weight of water equal to 2000 pounds; for it appears that anciently, a cubic foot of water, weighing 62½ pounds, was assumed as a general standard for liquids. This cubic foot, multiplied by 32, gives 2000, the original weight of a ton. Hence 8 cubic feet of water made a hogshead, and 4 hogsheads a ton, in capacity and denomination as well as weight.

TOP-HAMPER. Any unnecessary weight aloft, either on the top-side of the ship or about its tops and rigging.

TOP AND BUTT. A method of working English plank so as to make good conversion. As the plank runs very narrow at the top clear of sap, this is done by disposing the top-end of every plank within six feet of the butt end of the plank above or below it, letting every plank work as broad as it will hold clear of sap, by which method only can every other seam produce a fair edge. *(See Planking, Plate III.)*

TOPSIDE. A name given to all that part of a ship's side above the main-wales.

TOP-TIMBERS. The timbers which form the topside. The first general tier which reach the top are called long top-timbers, and those below are called the short top-timbers. *(See Frames. See also Disposition, Plate III. and Midship Section, Plate III.)*

TOP-TIMBER LINE. The curve limiting the height of the sheer at the given breadth of the top-timbers.

TOP-TIMBER HALF-BREADTH. A section containing one half of the ship, at the height of the top-timber line, perpendicular to the plane of elevation.

TOP-TIMBER SWEEP. *(See* Frames.)

TOUCH. The broadest part of a plank worked top and butt, which place is six feet from the butt-end, or, the middle of a plank worked anchor-stock fashion. Also the sudden angles of the stern-timbers at the counters, &c.

TRAIL-BOARDS. A term for the carved work, between the cheeks at the heel of the figure.

TRANSOMS. The thwartship timbers which are bolted to the stern-post, in order to form the buttock; and of which the curves, forming the *round aft*, are represented on the horizontal, or half-breadth plan of the ship. *(See Sheer Draught, Plate I.)*

TRANSOM-KNEES. Knees bolted to the transoms, and the side of the ship in the direction of the transoms. These knees when they cross the transoms are called Sleepers.

TRANSPORTING. Moving a ship from one situation to another by hawsers only.

TRANSPORTING-BLOCKS. Two snatch blocks, fitted one on each side above the taffarel to admit a hawser, when transporting the ship from one place to another.

TRANSVERSE SECTION. A thwartship view of any part of the ship; but may be more properly applied when the section is not strictly athwartships. *(See Midship Section, Plate III.)*

TREAD OF THE KEEL. The whole length of the keel upon a straight line.

TRICING BATTENS. Battens about two inches thick and four inches broad, nailed up under the deck between the beams, and which the sailors trice up the middle of their hammocks out of the head-way.

To TRIM. To work or finish any piece of timber or plank into its proper form or shape.

TREENAILS. Cylindrical oak pins driven through the planks and timbers of a vessel to fasten or connect them together. These certainly make the best fastenings when driven quite through, and caulked or wedged inside. They should be made of the very best oak split out near the butt, and perfectly dry or well seasoned.

TRUSS. Short pieces of carved work, mostly in small ships, fitted under the taffarel in the same manner as the term-pieces.

THE TUCK. The aft part of the ship where the ends of the planks of the bottom are terminated by the tuck-rail, and all below the wing-transom when it partakes of the figure of the wing-transom as far as the fashion-pieces. (*See* Square Tuck.)

TUCK-RAIL. The rail which is wrought well with the upper side of the wing-transom, and forms a rabbet for the purpose of caulking the butt ends of the planks of the bottom. (*See Sheer Draught, Plate I.*)

TUMBLING HOME, or FALLING HOME. The inclination of the top-side from a perpendicular towards the centre or the middle of the ship. The top-sides of three-decked ships have the greatest tumbling home, for the purpose of clearing the upper works from the smoke and fire of the lower guns. The advantages and disadvantages of tumbling home sides will be found discussed hereafter.

UNDER. A term applied to any bevelling that is within a square, or forming an acute angle. (*See* Bevelling.)

To UNSHIP. To remove any thing from its place, or the situation in which it is generally used. Thus, to unship the tiller, is to take it out of the rudder-head.

VOYAL. A large rope, used to unmoor, or heave up the anchor, by communicating the effect of the capstan to the cable.

UPPER BREADTH-SWEEP. (*See* Frames.)

UPPER-DECK. The highest of those decks which are continued throughout the whole length of a ship, without falls or interruption. (*See Inboard Works, Plate IV. and its Plan, Plate III.*)

UPPER HEIGHT of BREADTH. (*See* Height of Breadth.)

UPPER STRAKE OF BOATS. A strake thicker than those of the bottom, wrought round the gun-wales.

UPPER WORKS. A general name given to all that part of the ship above the wales; or all that part which may be considered as separated from the bottom by the main-wale. (*See Sheer Draught, Plate I.*)

UPRIGHT. The position of a ship when she neither inclines to one side nor the other. Hence any thing is said to be upright when square with, or perpendicular to, the keel.

As the ship when building lies with a declivity for the purpose of launching, it is evident, that every thing within her intended to be perpendicular or upright, when afloat, must be set so much farther aft as its upper part or head inclines from a plumb or perpendicular in its length, according to the angle made by the declivity of the ship in the same length.

WAIST. A name given to that part of the top-side above the upper deck, between the main and fore drifts. (*See Sheer Draught, Plate I.*)

WALES. The principal strakes of thickstuff wrought on the outside of the ship upon the main-breadth, or broadest part of the body, and which are called the *main-wales*. Also those that are wrought between the ports, which are called the channel-wales and middle or sheer-wales. The *main-wales* are the lower wales, which are generally placed on the lower breadth. (*See the respective Articles. See also Sheer Draught, Plate I.*)

WALL-SIDED. A term applied to the top-sides of a ship when the main-breadth is continued very low down and very high up, so that the top-sides appear straight and upright like a wall.

WARD-ROOM. The apartment in which the officers mess, &c. next under the captain's cabin.

WASH-BOARD. A shifting strake along the top-sides of a small vessel, used occasionally to keep out the sea. (*See Long Boat, Plate IV.*)

WATER LINES, or LINES of FLOATATION. Those horizontal lines, supposed to be described by the surface of the water on the bottom of a ship, and which are exhibited at certain depths upon the sheer-draught. Of these, the most particular are those denominated the *Light Water Line* and the *Load Water Line;* the former, namely, the light-water line, being that line which shews the depression of the ship's body in the water, when light or unladen, as when first launched; and the latter, which exhibits the same when laden with her guns and ballast or cargo. (*See Sheer Draught, Plate I.*) In the half-breadth plan these lines are curves limiting the half-breadth of the ship at the height of the corresponding lines in the sheer-plan.

WATER WAYS. The edge of the deck next the timbers, which is wrought thicker than the rest of the deck, and so hollowed to the thickness of the deck as to form a gutter or channel for the water to run through the scuppers. (*See Upper Deck Plan, Plate III. and Midship Section, Plate III.*)

WEDGE. A triangular solid, much used in the construction of a ship, and too well known to need description. It is one of the mechanic powers, the most simple and of the greatest force. (*See* MECHANICS.)

WELL. The apartment formed in the middle of the hold, by bulk heads erected to inclose the pumps, and protect them from injury, which might otherwise accrue from the lading and ballast, and also to give ready admittance for examining the state of the pumps, &c. (*See Inboard Works, Plate IV.*)

The well in a fishing smack is a strong apartment to contain live fish, built water-tight in the middle of the hold, with a number of holes through its bottom, by means of which the fish are continually supplied with water, and preserved alive.

WELL also implies in the same range or even with a surface.

WELL-GROWN. This term implies that the grain of the wood follows the shape required, as in knee timber, &c.

WHELPS. The brackets or projecting parts of a capstan from the barrel. (*See* CAPSTAN.)

WHOLE-MOULDED. A term applied to the bodies of those ships which are so constructed, that one mould made to the midship bend, with the addition of a floor-hollow, will mould all the timbers below the main-breadth, in the square-body.

Before the art of ship-building was brought to its present perfection, the method of whole-moulding was in great repute, and was much practised by the unskilful; as, however, the art improved, this method became less approved of in the construction of ships, whose form of the midship bend was required to be such, that if they were whole-moulded nearly forward and aft, they would not only be incapable of rising in a heavy sea, but be deprived in a great measure of the more advantageous use of the rudder; for, by whole-moulding, no more is narrowed at the floor than at the main-breadth; nor must the rising line lift any more than the lower height of breadth, which according to the form of some midship-bends, would make a very ill constructed body.

How far whole moulding may be used without injury may be seen by the Long Boat treated of hereafter; boats being now the only vessels in which this method is practised.

WINCH. A small windlass, with an iron axis, hung in rhodings or gudgeons, with a conical piece of timber at each end without the cheeks. It is heaved round by two iron handles, formed by cranks or winches, from which it takes its name.

WINDING. Twisting or curving. Hence the expression "winding" is used in opposition to "out of winding." (*See* OUT OF WINDING.)

WINDING-BOARD, is a piece of deal on which the windings of the side counter timber is marked, and from which the outside of the said timber is trimmed by a batten kept out of winding by the marks on the board, and a mould made to the shape of the topside.

WINDLASS. An horizontal machine, composed of timber, and used in merchant ships for heaving up their anchors in lieu of a capstan. (*See Inboard Work, Plate IV. and Upper Deck Plan, Plate III.*)

WINDLASS-CHOCKS. Pieces of oak or elm, fastened to the sides of small vessels, and by which the ends of the windlass are suspended.

WINGS. The places next the side upon the orlop, usually parted off in ships of war, that the carpenter and his crew may have access round the ship, in time of action, to plug up shot holes, &c.

WING-TRANSOM. The uppermost transom in the stern-frame, upon which the heels of the counter timbers are let in and rest. It is by some called the main-transoms. (*See Sheer Draught, Plate I.*)

WITHIN-BOARD. Within the ship.

WITHOUT-BOARD. Without the ship.

WOOD AND WOOD. This term implies that when a treenail, &c. is driven through its point is directly even with the inside surface, whether plank or timber.

WOOD-LOCK. A piece of elm or oak, closely fitted, and sheathed with copper, in the throating or score of the pintle, near the load-water line; so that, when the rudder is hung, and the wood-lock nailed in its place, it cannot rise, because the latter butts against the underside of the brace and butt of the score. (*See Sheer Draught, Plate I.*)

WRAIN-BOLTS. Ring bolts, used when planking with two or more forelock holes in the end for taking in the sett, as the plank, &c. works nearer to the timbers.

WRAIN-STAVES. A sort of stout billets of tough wood, tapered at the ends so as to go into the ring of the wrain-bolt to make the sets necessary for bringing-to the planks or thickstuff to the timbers.

WRING-HEADS. An ancient name given to that part of the ship near the floor-heads and second futtock heels, which, when a ship lies aground, bears the greatest strain.

YARDS. The long cylindrical pieces of timber, suspended upon the masts to extend the sails to the wind.

YACHT. A vessel of state or pleasure, usually employed to carry noble personages, and accordingly fitted with convenient apartments and suitable furniture.

YAWL. (*See* BOATS.)

OBSERVATIONS

ON THE

FIGURE AND CONSTRUCTION OF SHIPS AND VESSELS IN GENERAL.

THE chief properties which every ship ought to possess, are, in a certain degree, subversive of, or in opposition to, each other; inasmuch as one figure is required for swiftness, and another for strength or capacity; and all must be regulated by the particular circumstances or designation of the intended vessel. The great art therefore consists, in so forming the body, that none of the desired qualities shall be entirely wanting, but that all shall be combined to a certain extent; giving the preference to those which are more peculiarly required in the service for which the vessel is designed.

The first and principal point, in forming a ship, whether intended for war or commerce, is, that she shall be a good sea boat; or, in other words, that she shall be able to endure, with the least possible injury, the shock of the contending elements, winds and waves.

The next object will be, to give the vessel that quality which, consistently with her destined purposes, will give her swiftness or velocity. Here arises an obstacle to perfection in the former case: the vessel of greatest draught being best calculated to make her way against adverse winds; for, having the greatest hold of the water, she is, of course, the least liable to fall to leeward; while another, of less draught, is proportionally more buoyant, and so much the better fitted for services in which particular expedition is required.

The perfection of every ship, whether intended for war or commerce, may be comprehended in four words; STRENGTH, CAPACITY, STABILITY, and SWIFTNESS; as the primary quality of safety, and the secondary qualities of steering well, working well, rolling and pitching easily, are naturally comprised therein.

The STRENGTH of a ship may be said to be in its perfection, when sufficient solidity is given to those parts that are subject to receive sudden and violent action, from the impulse of any force acting upon them; and, when sufficient strength is equally diffused throughout the whole, so that every weight shall have adequate support, and be equal to the resistance of any strain, or the operation of any irregular motion.

The best methods of imparting a due degree of strength to every part of a ship, will be amply considered hereafter, when treating upon the actual construction.

With respect to STIFFNESS or STABILITY, it may here be observed that, in the construction of a ship of war, the first point to be attended to is, that she shall be so formed as to carry her lower tier of guns at a sufficient height from the water, in all weathers; otherwise they may be rendered useless. For a three-decked ship that cannot open her lower tier of ports upon a wind, but in smooth water only, may be taken by a seventy-four-gun ship, properly constructed, so as to keep her lower-deck ports open. The same may be said of a seventy-four-gun ship, not having sufficient stability; for she may be as easily taken by a thirty-eight-gun frigate, that can make use of all her guns; because, it is evident, that the frigate will then be the most formidable.

Hence we see, that the first thing to be considered in the construction of a ship of war is, to determine on the height of the gun-deck ports above the water at the lowest place, which is commonly at ⊕, or the midships. This we find, in line of battle ships, should invariably be from five to six feet; in frigates, from six to seven feet; and in sloops, cutters, &c. from four to five feet.

And, hence, we have the height of the Line of Floatation, or Load-Water Line, at the midships, or where the ports are lowest. Then, by determining whether the vessel should float on an even keel, or draw more water abaft than forward, we determine on the line of floatation, or load-water line, of a ship of war, with respect to the ports.

Merchant ships are generally constructed to carry a certain cargo, and their principal dimensions are determined according to the trade for which they are particularly designed; therefore the line of floatation, or load-water line, is not in them so exactly confined to a certain height.

The particular qualities required in a ship must ever regulate the figure of her bottom: a ship of war, therefore, must be formed so as to sail swiftly, and carry her lower tier of guns sufficiently out of the water. A merchant ship ought not only to contain a large cargo, but ought also to be fitted so as to be navigated with few hands; and both should have sufficient stability to enable them to carry a press of sail: they should steer well; drive little to leeward; and sustain the shocks of the sea without being violently strained.

The first thing to be established in the draught of a ship is her length; and, as a ship of war, according to her rate, is furnished with a certain number of guns, which are placed in battery on her decks, it is necessary that a sufficient distance should be left between their ports to work the guns with facility, and particularly to leave space enough between the foremost gun and the stem, and between the aftmost gun and the stern-post, on each side, on account of the arching or inward curve of the ship towards her extremities.

When the length of a ship is determined, it is usual to fix the breadth by the dimensions of the midship beam; which are generally regulated according to the experience of the builder, and the particular services for which the ship is designed. Hence have arisen that variety of standards, or general rules, adopted by different artists, who have been accordingly divided in their opinions with respect to the breadth which ought to be assigned to a ship, relatively with her length. Those who would diminish the breadth have alledged, and truly, that a narrow vessel meets with less resistance in passing through the water; 2dly, that by increasing the length she will drive less to leeward; 3dly, that, according to this principle, the water lines will be more conveniently formed to divide the fluid; 4thly, that a long and narrow ship will require less sail to advance swiftly; that her masts will be lower and her rigging lighter; and, by consequence, the seamen less fatigued with managing the sails, &c.

The reasons given, on the contrary, for enlarging the breadth, appear equally cogent. These are, 1st, that this form is better fitted to preserve a good battery of guns; 2dly, that there will be more room to work the guns conveniently; 3dly, that by carrying more sail the ship will be enabled to run faster; or, that this quality will at least overbalance the advantage which the others have of more easily dividing the fluid; 4thly, that, being broader at the load-water line, or line of floatation, they will admit of being very narrow on the floor, particularly towards the extremities; and, 5thly, that a broad vessel will more readily rise upon the waves than a narrow one, &c.

All these particulars, however true in themselves, individually considered, are accompanied with their peculiar disadvantages. As, for instance, it will be evident, that, if the bow of a ship be narrow, it must unavoidably pitch deeper than one which is broader, even with a small degree of impulsion *. This can be remedied only by having its forebody so formed, that its bearings shall catch the vessel in its descent; or, in other words, by an increase of breadth or expansion upwards.

It will be necessary at the same time, that the remaining part of the hull shall be so proportioned, that its effects may not counteract the advantages arising from the figure of the fore-body; for, if the after part be not, in like manner, supported by proper bearings, it will dip into the hollow of the sea, and be so much the more liable to the danger of being pooped than if the bow were narrower †. A vessel so constructed, and possessing length or other requisites conducing to make her wealtherly, may, if close hauled upon a wind, drive along with more than usual velocity, without dipping or sinking at every wave she meets with; but the great inconvenience will be, the danger that would inevitably exist both with respect to the masts and to the vessel.

On the form of the stern depends the prompt obedience of the vessel to the helm: a proper medium must, nevertheless, be observed. If too fine and taper, the disadvantages that we have just noticed will arise; on the contrary, if too full, the vessel will not be under proper command; for the vacuum (if it may be so called) created by the passage of the hull through the water, will, in this case, extend farther than the width of the rudder; and, consequently, deprive it of its best force. But, although it is extremely requisite that all fullness in the after-body should be carefully avoided below the line of floatation, yet immediately above it the quarter should spread out, in order to present a sufficient quantity of support when the ship rises forward to a sea; and, in order to 'scend without danger of

* The movements of pitching are the most dangerous of any to which a ship is subject; as they are those which most fatigue a ship and her masts. It is mostly in one of these motions that masts are seen to break, particularly when the head rises after having pitched.

† To be *pooped*, signifies, to decline so much abaft as to dip the upper part of the stern in the sea; or so much as to permit the sea to break heavily over the stern.

having her stern driven in by the force of waves that may strike her in that direction.

The stability, or stiffness, of a ship, is that quality by which, when she receives an impulse or pressure in a horizontal direction, so as to be inclined in a small degree, the vessel will regain its former position as the pressure is taken off. This quality, and the want of it, namely, the propensity of a ship to roll, depends chiefly on the figure of the midship bend.

That the nearer the midship body approaches to a cylindrical shape, the more will the ship be subject to roll, is a truth which needs no demonstration. It will be equally liable to upset if the body be too sharp, as we shall hereafter shew; besides the inconveniences of increased draught of water and smaller stowage. A vessel having a flat bottom, and perpendicular sides below the line of floatation, has the greatest stiffness; but such a vessel would, by not being sufficiently lively to yield to the sea when it runs high, be liable to have it frequently beating over her as it would over a rock. A medium, therefore, must be obtained, which shall obviate these disadvantages respectively.

The propensity to rolling, derived from the form of the midship body, may, in some degree, be obviated or reduced, particularly in a vessel of large capacity, by the length, or the peculiar qualities of the fore and after bodies; but the question is, whether the remedy would not be productive of much greater inconveniencies.

It may be noticed here, that, according to the opinion of the best judges, in the midship frame generally, the floor should be flat, the upper futtock straight, and the extreme breadth elevated above the line of floatation.

The property of stability, as before observed, may, certainly, be considered as the first quality to be attended to in the formation and construction of a ship; inasmuch as, if that be wanting to a certain degree, it will be incapable of putting to sea with any degree of safety. Hence, therefore, the stability of a ship, whether for war or commerce, is the first property to be attended to; since, for want of it, a ship will incline too much, or lie over in the water; and, in case of action, this defect may render, in war, the lower tier of guns entirely useless.

With regard to the sailing trim of a vessel; it is the decided opinion of the most scientific men, that ships or vessels of the larger classes should always be so constructed as to sail with, or nearly with, an even keel. When constructed so as not to sail on an even keel, they draw more water abaft than forward, that being found most advantageous both to their sailing and steerage. Smaller vessels, in general, draw more water abaft than forward: some, as packets, &c. built for dispatch, considerably more so. Cutters have been, commonly, so constructed. The utility of a vessel's sailing on an even keel is considerable; as, by preserving a proper equilibrium, it preserves the trim of stowage, &c. Of such vessels it is to be particularly observed, that the breadth should be carried well forward; that the body shall diminish gradually abaft from midships; and, that the water lines forward shall not be inflected or hollow; as such are, by no means, adapted for velocity.

If built to draw more water abaft than forward, the main breadth must be raised abaft; which, consequently, will make the after body the cleaner, and so permit it to decline deeper into the water.

THE PRINCIPAL POINTS or requisites which are essential to the perfection of every vessel, are, that she shall be easy at sea; that is, go smoothly and easily through the water; rising to the sea when it runs high, and she under her courses, or lying to under a main sail; otherwise she will be in great danger of having her masts carried away; that she shall be stiff under sail, so as neither to pitch nor roll, and be able to carry a good sail, so as to double a cape, or get off from a lee-shore, with facility: that she shall steer well; and, with the utmost promptitude, answer to the least motion of her helm in all situations.

A ship should, also, not only sail well before the wind, when large, but, particularly, when close hauled, to keep a good wind, and not be leewardly, or fall off to leeward.

To unite, in perfection, and in one ship, all these desirable qualities, some of which are subversive of others, is impossible. We must therefore be satisfied if we gain that one in an eminent degree which forms the main point of the design; and, with obtaining so much of the others as may be practicable, consistently therewith.

OF STABILITY OR STIFFNESS, &c.

THE stability or stiffness of vessels, by which they are enabled to carry a sufficient quantity of sail, without danger or inconvenience, is no less essential to the safety of navigation than capacity; for, without it, a ship is totally disqualified for the purposes of war; in particular, by being unable to use her guns with effect, or carry a press of sail in case of emergency.

Although the wind may, in one sense, be said to constitute the power by which ships are moved forward in the sea, yet, if it acts on a vessel deficient in stability, the effect will be to incline the ship from the upright, rather than to propel it forward: stability is therefore not less necessary than the impulses of the wind are to the progressive motion of vessels.

VESSELS which have a sufficient degree of stability, arising from their construction, will certainly sail faster than others, which, in order to carry the same quantity of sail, require to be ballasted with a much greater weight; for the latter, so ballasted, will be much more liable to roll than the former.

A vessel that is broad and shallow has much more stiffness than one that is narrow and deep; and an increase of breadth will produce an increase of stability: but the expense of construction would also be materially increased, according to the usual mode of computation, and the sailing of the ship may be retarded, as she certainly would be leewardly even under little sail, which ought to be particularly guarded against, especially in constructing large ships of war.

To increase the depth or draught of water, would lower the centre of gravity and increase the weight: this would operate against velocity, because the resistance is as the quantity of water to be removed; or, nearly, as the area of a thwartship section of the immersed part of the body at the midship bend. It would, at the same time, render the immersed body of a figure less proper to separate the line of support from the centre of gravity, so that the effect on one side would be in some measure destroyed on the other; and, by lowering the centre of gravity too much, the ship would labour excessively, and too large a draught of water is both dangerous and inexpedient.

But, by adding to the length the stability will be increased, the centre of gravity lowered if necessary, the form rendered at once fitter for separating the line of support from the centre of gravity, and finding less resistance from the fluid, especially when sailing on a wind, a case of the utmost importance.

Yet, although an increase of length would enable a vessel to carry the most sail, and sail the fastest, it must not be carried to an extreme; because, if so constructed, a vessel would neither tack nor veer so quickly; neither would she lift or rise in a sea like a shorter vessel; she would strain more, and be very liable to have the sea break over her. The influence of the rudder may be weakened and may even be totally lost. The greatest judgment is, therefore, required in proportioning the length, which may be proportionally greater in those vessels that generally navigate in the smoother seas, or are not intended to be deeply laden.

In order, therefore, to construct a ship that shall be stiff under sail, or, in other words, have sufficient stability, we must determine to have a flat floor and sufficient length; the lower futtock pretty full; the upper futtock nearly straight; and breadth thrown out aloft to carry the main breadth pretty high; upper works as light and as low as possible; and so constructed as to keep the centre of gravity low. But, in ships of war, the centre of gravity can never be far removed from the load-water line, for could it be placed lower it is not to be desired; as the farther it is removed from the load-water line the motion of the ship becomes uneasy.

Here it may be proper to notice, that the stability of many ships, however perfect in construction, may be materially injured by improper trim or an injudicious mode of stowage; although, on the contrary, defects in the construction can be seldom rectified, to any considerable degree, by the stowage. To illustrate this point as clearly as possible, let us suppose a vessel, of the most correct construction and possessed of great stability, to have the whole of her bottom filled with commodities, of the lightest nature, as high as her extreme breadth; let her then receive as much lead, or other heavy matter, on board, as will bring her down to her load water mark. If the vessel were sent to sea in this condition, it would be next to a miracle when compelled to sail upon a wind, if she did not overset; but, if the cargo were transposed, the same vessel might stand unrivalled in that very point wherein her deficiency had before appeared so conspicuous.

TO FORM A SHIP SO AS TO STEER WELL, AND QUICKLY ANSWER HER HELM.

In order that a ship may steer well, and quickly answer her helm, the Wing Transom should be carried pretty *high*, or about three-fourths of the height of the top-timber line in midships, and the fashion-pieces well formed and not full below the load-water line, but so that the form of the vessel may come very clean, or sharp, as it approaches the keel aft; the midship frame should be placed about five-twelfths of the length from forward, and the greater the proportional length of the ship is to her breadth, the midship bend should be proportionally farther forward; as the sloping, or angles, of the water lines at the stem and stern are necessarily sharper or more acute in a long than in a short ship; that is to say, proportioned to the breadth. The ship to draw rather more water abaft than afore; to have her bow rake about three-tenths of her extreme breadth, and the stern post to rake between one and two inches in every foot of the length of the post; the quarter deck and forecastle, and all the upper works, to be kept as light and low as possible; all of which certainly tend to make a ship go well, and quickly answer her helm; for a ship that goes easily and quickly will always steer well; and, possessing this quality in perfection, she will stay, veer, and incline to the larboard or to the starboard promptly. It is evident, that the effect of the rudder must depend, in great measure, on the cleanness of the vessel's run, so that the fluid shall have an unimpeded passage to it, whereby its inclination shall have the greatest effect on the water.

TO FORM A SHIP WITH SUCH CAPACITY AS TO CARRY HER GUNS WELL ABOVE THE WATER.

THAT a ship may carry her guns well upon the water, a long floor timber will be necessary, and not much rising; the midship frame to be very full; upper futtocks near a straight; upper works to be very light and the wing transom not placed too high; all of which will combine to make a ship carry her guns well out of the water.

OF THE FORM BEST ADAPTED TO GO SMOOTHLY.

THAT a ship may go smoothly through the water, it will be necessary for her to be so proportioned as not to be subject to those violent and irregular movements which tend to impede the velocity, and, by force of strain, to destroy the vessel. To prevent rolling, great proportional breadth, and sides nearly upright towards the plane of floatation, are favourable. To prevent pitching hard, give her a long keel, a long floor, with little rising afore and abaft; the displacement of the fore body to be duly proportioned to that of the after body, and hollow water lines forward to be carefully avoided in the construction *. In this case, correct stowage will be a powerful auxiliary to the accuracy of construction. For if, to prevent rolling, all the heavier bodies be removed as far as possible, from the longitudinal axis; and, to prevent pitching, if all such bodies be stowed as much as possible towards the transverse axis of the ship; these movements will be found to prevail considerably less than under the circumstances of a different mode of construction or stowage; and the ad-

* By "*hollow water lines*" are meant, such water lines as curve inwards.

A remark, made by a late writer on water lines, states, that their fairness can, in no respect, be a matter of great importance, since they are all formed on the supposition that the vessel always floats upright in the water; a position she can seldom be in when under sail; and, since the immersed part must alter its form as often as it alters its position. Of this remark, granting the latter part of it, we may observe, that it is also as certain that, in the body of every vessel, of which the horizontal lines, vertical lines, and sections, are fair in the construction, will also produce fair lines in any position: and the form of the water lines, however altered by the inclination of the vessel, may be drawn, and will prove the assertion to be false.

vantages will be great, not merely in obviating the quick oscillatory movements of rolling, but also the accelerated, or pitching, motions fore and aft, so much more to be dreaded, occasioned by hollow seas, hollow water lines, and great weights at the extremities of the vessel.

A due regard to these particulars, will certainly be the means of causing a ship to go the more smoothly through the water.

ON THE FORM BEST CALCULATED TO HOLD A GOOD WIND, &c.

The quality of being weatherly, or of holding a wind well, may be defined as the power which a vessel possesses of keeping her course with the least possible deflection when opposed by an adverse wind. This quality may be either effected by the peculiar form of the hull itself, or by artificial auxiliaries, as lee boards, additional keels, &c.

A full-bodied vessel, as before noticed, is infinitely less capable of holding a direct course than one of a sharper description. The reason is obvious. The opposition to the water is, in the former instance, oblique; in the latter it approaches more nearly to a direct plane.

To give a ship that form which shall make her weatherly, or, in other words, to keep a good wind and sail swiftly, she must have a great length and good depth of keel; her breadth not too great; her sides not kept parallel, or the extreme breadth not continued, too far aft; as this would be against velocity. Every succeeding water line should be more delicate in approaching toward the keel; and not hollow forward, as before observed. If a good depth in hold be given, the ship will, of course, have a short floor and a great rising; and, as she will feel great resistance sideways, or on her broadside, with little resistance a-head, she will, consequently, sail fast, and not fall much to leeward.

OBSERVATIONS ON THE WHOLE OF THE PARTICULARS DESCRIBED IN THE FOREGOING SECTIONS, AND ON THE PROPORTIONING OF SHIPS' BODIES IN GENERAL.

It may be urged that it is not possible to make a ship at once carry her guns well above water, carry a good sail, and be a fast sailer; because it would require a very full bottom to acquire the two former qualities, and a sharp one to gain the latter; but, if we consider, that a full ship will carry a great deal more sail than a sharp one, we may perceive the possibility of constructing the body so as to possess these three qualities, and likewise to steer well; in order to which a good length must be given.

From what we have said under this head, the Reader may, perhaps, infer, that the four qualities above mentioned may be so united that each of them may be discerned in some degree of eminence: we shall therefore repeat, that all of them cannot possibly be existent in any one body to a degree of perfection. We must, therefore, while we retain a portion of each, give the superiority to that which is most consistent with the purposes for which the ship is peculiarly designed. Some very eminent geometricians have, indeed, endeavoured to find the form of a solid which should possess all these properties, and meet with the least resistance in dividing the fluid; but they have not been able to reduce their theory to practice, by reason of the different positions assumed by a ship when under sail. Many who have despaired of establishing these points by mathematical rules, have applied themselves wholly to their own local observations and experience, which may, and doubtless have, in some cases, served as a substitute for more correct science. Yet, although it may in this manner have been discovered that some vessels have had bad qualities from which others were exempt, and the contrary, it could not be determined wherein the fault, or the advantage, lay; whether in the Hull, in the Sails, or in the Rigging. Hence no remedy could be applied, no certain rule deduced.

GENERAL OBSERVATIONS TO BE CONSIDERED IN THE PROPORTIONING OF SHIPS' BODIES.

The Midship-bend, or extreme breadth of a vessel, may either be placed in the middle of its length, or farther aft or farther forward, whilst the quantity of bulk shall remain the same in the whole. By placing it farther abaft, the lines that form the fore end of the ship will run the nearer to a parallel with the keel, and, consequently, may appear to give the less absolute resistance to the opposing water: but, it has long since been found, by experience, that the place of the midship frame of all vessels should be afore the middle of their length, as the fore part of the ship will thereby become fuller than the after part: and, consequently, a ship so formed, after having once opened a column of water, will meet with less resistance in passing through it. Other advantages attend the forward position of the midship-bend; the ship will lift easier in a heavy sea, and, in that case, necessarily sail faster; she will have more capacity, and be less liable to hog or break her sheer; and, what is of very material advantage, will admit the foremast to be placed farther aft; for the more acute the bow is, the greater quantity of head sail is required, (though less able to support it,) that the centre of effort of the sails may meet the resistance of the water on the bow when sailing by the wind.

Supposing that a ship had all the perfections in her dimensions, and the midship-bend placed near the middle, but built sharp at the ends; if we consider the weight of the foremast and bowsprit, with their rigging and sails, and the weight of the anchors at the bows, we may easily conceive that, with the pressure of the wind upon the sails, the support in or bearings of the fore body would be insufficient to prevent it from pressing down into the hollow of every sea. The support would only be in the body farther aft, and this would tend to plunge her head still deeper, and retard the velocity.

Another consideration is, that the quantity of opposing surface in the bottom should not be equal forward to the quantity of surface abaft; for, if it were, the ship must be trimmed greatly by the stern, or her rudder would not command her to bear up in a gale of wind. When a ship is pressed with sail, the water is forced up at the bow above the horizontal, and the ship likewise pressed down, which amounts nearly to the same, with respect to her helm, as if the ship was trimmed by the head: again, ships that carry their tiller near the middle in light winds, require it more a-weather when the wind blows.

Now, it is plain, that the placing of the midship bend is of the utmost consequence in the construction of a ship's body; and, it appears very clear, from what has been said, that a ship with the midship bend placed nearer forward than aft, which will consequently make the fore body more full, will best answer every purpose, especially that of velocity.

And, although it is plain, that by so doing, the entrance of the ship will be the more full, and will present, apparently, more absolute force against the current of water than when the midship bend is placed nearer to the middle of the ship; yet, by moving that bend nearer to the fore end of the ship, the body will decline horizontally so much the quicker, and part of the effect of that resistance caused by the lateral pressure of the water will be taken off; which must, certainly, be of more service to the velocity than what is lost by making the fore part of the ship somewhat fuller; and seems to promise the connection of capacity and velocity, the two great objects to be pursued in the construction of ships' bodies.

And we may now venture to assert, upon the premises which we have adduced, that, by carrying the midship bend forward, we shall gain not only in point of velocity, but likewise in point of steerage, which will be a double advantage.

In addition to what has been already said with regard to the sailing trim of a vessel, in the first section of this chapter, it may be observed, that, however advantageous it may be thought for a vessel to sail on an even keel, yet, in the opinion of many persons, the extreme breadth of a ship should always be higher abaft than in midships, by about one sixth of the load draught of water; which, in consequence, will make the ship draw more water abaft than afore. The reason assigned is, that, as the fore part cannot so readily divide the water, when the keel is parallel to the surface as when it is inclined to the stern, the vessel will sail better: and this is the general opinion of seamen, who have frequently remarked, that it is necessary to make her draw more water abaft than afore; whereby they, at least, gain this advantage, that the ship will answer her helm better: but, it will, in construction, occasion the decks to be raised higher abaft than afore.

That the extreme breadth should also be raised considerably more afore than abaft, is recommended for these reasons:—when a ship is close hauled by the wind, and lies much over, the weather side will lose much of the breadth; whereas, on the contrary, the lee side will gain considerably; the ship then displaces a greater quantity of water on the lee side, and, according to the manner in which fluids act, should be supported with greater force, and, of consequence, be able to carry the greater sail. Hence, it is plain, that, by raising the breadths, we keep them as a reserve to be used when a ship stands most in need of relief, that is, when she lies most over.

It may here be remarked, that flat-floored ships do not require their breadths to be raised so high afore and abaft; because, carrying all the weight of their cargo low, they are thereby made capable of carrying a greater stress of sail.

The several excellencies and defects which we have pointed out, as above, may be constantly seen existing, in a greater or less degree, in the several classes of shipping which compose the naval force of Britain, as well as of those which are employed in carrying on the commerce of the country and its intercourse with foreign states. Our first-rate ships in general, especially those of greatest stability, are admirable ships in every respect; as they sail well, and combine almost every good quality. Large as they are, they are perfectly manageable; and their evolutions are generally made with wonderful facility.

Our Second Rates, or rather, our ships of ninety guns, have, too generally, those defects in their construction which contribute to instability: arising from want of that capacity which most of the first rates possess; and, having it, have the chief corrective against instability in three-decked ships, wherein the centre of gravity is necessarily very high, and their form the least calculated to derive lateral support from the effort of the water.

Eighty-gun Ships were formerly constructed so as to carry their guns upon three-decks; and they were found, in consequence, more disproportionate in their parts, and less useful, than any other large ships in the service. Their topsides were so high above the water, to admit of having three tiers of guns, as to be out of all proportion for the length and breadth; nor could the lower ports be fixed at a sufficient height above water to admit of their being opened in blowing weather, even if not very rough; we admit, that the heights between decks and depth in the waist could not be much less than those of a ship of 100 or 90 guns, but must still observe, that they could not be duly proportioned in the water; that is, could not be brought down to that depth which would be found the best sailing trim, if properly constructed.

Ships of this description must therefore labour under many disadvantages, arising from their disproportionate height, even if their principal dimensions were similar in every other respect to those of ships in general. It were useless to enumerate all these disadvantages, because the defects which we have described are generally known and acknowledged. That eighty-gun ships of this class will be continued in the navy is not probable; and we have, therefore, no farther occasion to notice them in our work.

The ship of eighty guns upon two decks is, on the contrary and altogether, the most useful and valuable one in the service; and it is, with the enlarged seventy-four, of which we have herewith given the draught and dimensions, deservedly esteemed as the most perfect in the navy; and as possessing, to an eminent degree, all the properties of capacity, stability, and swiftness.

As two-decked ships, inferior to the seventy-four, are often required for expeditions and convoys during war, and as flag ships on foreign stations during peace, the sixty-four-gun ship has sometimes been used for these purposes. This ship has also frequently taken her place in line of battle. In the latter case her force has, however, been frequently found incompetent; the seventy-four, of which the French line is chiefly composed, being incomparably superior; and, in the former cases, the fifty-gun ship would equally answer, and at a still less expence. The latter is a very useful ship, although defective in its proportions; for, as its guns are carried upon two decks, the height and breadth are too great in proportion to the length. We have had, notwithstanding, several favourite ships of this class.

The Sixty-four gun ship may be considered, in relation to the seventy-four, as the ninety to the first rate; possessing the same defects, without compensatory qualities; and its continuance is, by no means, desirable in the navy. This is a truth acknowledged by the practice of our adversaries as sixty-fours have, for some time past, been disused in the French service.

FORTY-FOUR GUN SHIPS, constructed to carry their guns upon two decks, are as disproportionate in their parts as any other ships in the service. Being exactly on the same principle as the eighty-gun ship of three decks, the observations upon that apply directly to this. Nor is it generally used in battle. We may therefore also reject this as unworthy of farther notice.

Directly the reverse of this is the frigate constructed to carry forty-four guns upon one deck; the most powerful and most valuable of our frigates. That of which we now speak, rated as of forty-guns, may be so constructed as to have all the qualities which can possibly be united in one ship; for, having but one deck, the height may be in due proportion to the length; and, in consequence thereof, there will be required no more than a proportional breadth, by which she may be brought down in the water to that depth which is allowed to be the best sailing trim for ships in general. Here then is no obstacle to prevent her being duly qualified in point of velocity. Her dimensions, also, being greater than those of the forty-four with two decks, enables her to carry heavier metal, which must, consequently, render her a formidable ship. Hence it is, that this frigate may be ranked as the most valuable frigate of the English navy.

The frigates of thirty-eight and thirty-six guns are very little inferior in point of proportion and utility to the forty-four (rated as forty). As their force is less, they consequently require a smaller number of men, a less quantity of provisions, and are more readily equipped. The frigates of thirty-two guns are well proportioned; and, of course, equally estimable and useful. In short, our frigates, in general, are excellent cruisers; they sail well, and are remarkable for stability. These from thirty-six to forty-four guns upon one deck are, indeed, admirable: and the whole, together with our sloops of war, are highly eminent for their superior qualities.

As merchant-shipping, in general, is scarcely divisible into distinct classes, we cannot speak of it with that degree of precision, as of those of the royal navy; because their respective forms and dimensions are dependant, almost entirely, on the local practice, or the ideas of their respective constructors; and fluctuate accordingly.

The merchant-ship of 330 tons, of which the plans and dimensions are herewith given, is peculiarly adapted to the West India trade; and has been found to answer so well, that several ships have been built from the draught.

PRACTICAL RULES

FOR THE

CONSTRUCTION OF SHIPS, &c.

CHAPTER I.

GENERAL OBSERVATIONS AND DEFINITIONS.

THE first step towards building a ship from design is, to construct draughts for that purpose, namely, plans and sections drawn with all possible exactness, examined by proper calculations, and fit to be submitted to the most accurate scrutiny.

Of these, the principal are; first, the SHEER DRAUGHT, or plane of elevation, upon which the whole length of the ship is represented, according to a side view, perpendicular to the keel, as upon a section supposed to be cut by a plane passing through the middle line of the keel, stem, and stern-post. *(See Plate I.)*

Secondly, the BODY PLAN, or plane of projection, in which the ship is exhibited according to an end view, so as to present the outlines of her principal timbers, and shewing the projection of her frames relatively to each other. It is supposed to be described on a vertical section, at the midship bend, or broadest part of the ship, perpendicular to the sheer plan, and comprehends a delineation of the shape of every frame timber in the ship.

Thirdly, the HALF BREADTH or FLOOR-PLAN, supposed to be described by an horizontal section cutting the whole body of the ship, lengthwise, at the broadest place on each timber. On this draught, which is generally placed under the sheer draught, are described all the sections or curves that may be imagined to cut the ship horizontally, lengthwise, &c. In this draught the curves of the transoms, called the *Round-Aft*, are also marked, and sometimes the breadth and thickness of the timbers. It is called the *Floor-Plan*, as being that on which the whole frame is supposed to be erected, and as exhibiting the upper side of the keel, with all the floors, &c.

To the above may be added, the draughts exhibiting the DISPOSITION of the FRAME TIMBERS and PLANKING; the profile of the INBOARD WORKS, or interior of the ship; the PLANS of the DECKS, &c.

From the foregoing definitions it may readily be conceived, that the *Sheer Draught* determines the length and depth of the keel; the difference of the draughts of water; the length and projection, or *rake*, of the stem and stern post; the position of the midship and other frames upon the keel; the load-water and other water lines; the wales; the dimensions and situations of the ports; the projection of the rails of the head and stern gallery, with the stations of the masts and channels. That the *Body Plan* limits the different breadths of a ship in various points of her length, and exhibits the outline of the timbers respectively to each other, as they are erected upon the keel, with a variety of sections of the ship in different parts of her length, and always perpendicular to the surface of the water; so that the eye of the observer, when placed in what may be properly termed the longitudinal axis of the ship, may perceive the several sections at one glance; that is to say, when looking full on the stem, from before the ship, he shall distinguish all the fore timbers, or those in the fore-body; and, when looking from behind, directly on the stern, he shall perceive all those of the after-body. But, as the two sides of a ship ought to be exactly alike, it is judged sufficient to represent the sections of the fore part of the ship on the right side, and those in the after part on the left side, so as to perceive all the sections, as well afore as abaft, upon one plane.

With respect to the horizontal plane, or *Half Breadth Plan*, it may also be observed, that, when a ship floats upon the stream, it is evident that her upper works will be separated from the bottom by the surface of the water, which will accordingly describe an imaginary horizontal line upon the bottom from the stem to the stern-post.

The most elevated of these lines is that, called the *load water line*, which is supposed to be drawn by the surface of the water on the upper part of the bottom when she is fully laden.

If the ship be lightened of any part of her lading, and preserves the same difference in her draught of water at the two ends, or so as to preserve the same equilibrium of the keel with regard to the surface of the water, another line may be delineated upon the bottom, close to the surface of the water, which will be a second water line, parallel to the first, but nearer to the keel in proportion to the height which the ship has risen. Thus may a variety of water lines be drawn parallel to each other and to the load water line.

The construction of these, and of the other lines described on the three principal draughts, will be more fully understood by the following definitions, &c. which may be considered as supplementary to those given.

The Height of Breadth is, as before explained, the main breadth or broadest part of the ship, and is defined by two curved lines, called the Upper and Lower Height of Breadth Lines, as heretofore described.

The Main Half Breadth is a section, supposed to cut one half of the ship horizontally at the height of breadth. It comprehends, therefore, the broadest part of the ship from the middle line to the outside of every timber.

The Top-timber Line is a curve which generally terminates the height of the ship amidships, and also describes the sheer; it is likewise where the top-timber half breadth section, described beneath, cuts the ship fore and aft, or lengthwise.

The Top-timber Half-breadth is a section of one half of the ship, supposed to cut the ship horizontally at the height of the top-timber line.

WATER LINES are, as we have explained above, supposed to be drawn on the surface of a ship's bottom by the surface of the water on which she floats. They are generally drawn with green ink, and are represented in the sheer draught by straight lines. If parallel to the keel, they will be represented on the body plan by horizontal lines; but if the vessel is to be constructed so as to draw most water abaft, the water lines will not, of course, be parallel to the keel, but, owing to their varying heights, will form curves upon the body plan; and, in the half breadth plan they will be described by curves which limit the half breadth of the ship at the height of their corresponding lines in the sheer plan.

RIBBAND LINES are those curved lines, in the half breadth plan, by which moulds are made for the ribbands and harpins; and the use of the ribbands and harpins is, to keep the timbers which compose the body of the ship to their true stations, so as to preserve its true form until the plank is brought on. For this purpose they are skilfully arranged with regard to their heights and distances from each other. It is evident that the ribbands will partake of a double curve, owing to the convexity of the bottom of the ship. The curve, in the sheer plan, will increase perpendicularly on approaching the stem and stern post: and it will be clear that, by deviating from the middle line of the ship's length, as they approach the extreme breadth, the ribbands will also form an horizontal curve, as upon the half breadth plan. From this double curve it results, that the ribbands will appear in different points of view, when drawn upon different plans of the same ship. To conceive this, suppose a model of a ship upon the stocks completely framed as represented in the frontispiece. If we were placed in a line prolonged from the keel, facing either the stem or stern, we should only view the projection of the ribbands on the plane of the midship frame, in which the horizontal curve is scarcely seen, but we shall discover part of the perpendicular curve which rises gradually from the extreme breadth towards the stem and stern post, so that they must be drawn on the body plan as *diagonal lines*, which terminate on the midship frame, and, at the heights designed on the stem and stern-post. But, if we were placed considerably above the ship, on a line perpendicular to the middle of the keel, we should discern the horizontal curve as drawn in the half breadth plan, without perceiving the perpendicular curve as drawn in the sheer plan.

SWEEPS. The different sweeps or segments of circles which successively and connectively form a bend, or frame of timbers, have already been clearly described under the article FRAMES, in the Explanation of Terms. Of these, the segment which is called the FLOOR-SWEEP is that which forms the body at the floor-head, particularly along the midships. It is limited by a horizontal line above the keel in the body-plan, and its distance above the keel at the midship timbers is called the *Dead-Rising*.

The LOWER BREADTH SWEEP forms that part of the body immediately below the lower height of breadth. Its centre is found in a horizontal line, in the body plan, at the height of the lower breadth of its corresponding timber in the sheer plan, upon which line is set off the main half breadth of the ship, and from which the radius is taken that describes the sweep downwards.

The RECONCILING SWEEP connects the lower breadth and floor sweeps in such a manner as to intersect neither, but to come exactly over the back of each, so that the whole form a fair curve from the lower height of breadth down to the rising or floor sweep; and, by drawing a line from the back of the floor sweep down to the keel, we shall have the whole form of the timber below the lower height of breadth line.

The UPPER BREADTH SWEEP forms part of the body above the upper height of breadth. The centre of this sweep is in a horizontal line, in the body plan, corresponding with the upper height of breadth of the same timber in the sheer plan; to which line the corresponding main half breadth of each timber is squared up. Within this half-breadth is set off the radius or length of the sweep which gives the centre for describing as much of a circle upwards as is required. The lengths of all the upper breadth sweeps are to one radius.

The TOP-TIMBER SWEEP or HOLLOW, is a sweep inverted with its back to the back of the upper breadth sweep; its upper part intersects a spot at the top-timber half breadth at the height of the top-timber line. By this sweep, as we have before shewn, the form of the timber is completed.

The RISING OF THE FLOOR, is a curve drawn in the sheer-plan and limited at the midships by the dead-rising. In flat floored or burthensome ships it runs nearly parallel to the keel for some distance afore and abaft the midships. All the timbers where the rising is parallel with the keel are termed *flats*.

The HALF BREADTH of the RISING is a curve line in the half breadth plan which limits the distance of the centres of the floor sweeps from the middle line in the body plan.

The RISING LINE is a curve in the sheer draught which contains the heights of the centres of the floor sweeps, taken from the body-plan; but, if the whole height of those centres was set off upon corresponding timbers in the sheer plan, they would interpose with the upper lines in the draught; the rising line is, therefore, so contrived as to come to the lower part of the sheer-plan, by taking all the heights of the centres in the body-plan, from a horizontal line, at the height of the centre which sweeps dead-flat; and, setting them off on their corresponding timbers in the sheer-plan, from the upper edge of the rabbet of the keel, by which means the rising line in the midships breaks in fair with the upper edge of the rabbet of the keel. When the body is constructed by a rising floor, the floor sweeps are all of one length.

The CUTTING DOWN LINE is a curve line, in the sheer-plan, which limits the height of every floor timber at the middle line; and, likewise, the height of the upper side of the deadwood afore and abaft, which must be sufficiently high to allow for the siding of the keelson, and leave sufficient strength in the rising floors.

ROOM-AND-SPACE, or Timber and Room, is the distance between the moulding edges of all the timbers; or, rather, the siding of every two timbers and opening between: the timber being considered as the *Space* and the opening between as the *Room*. The Room-and-Space accordingly varies with the size of the ship; and, it must always be contrived, in draughting, so as to contain the siding of two timbers and the opening between, agreeably to the definition. In all ships of war, the breadth of the ports must here be always considered. It may be observed, that one mould serves for two timbers, the foreside of the one being supposed to unite with the aftside of the other, and so forming only one line, which is called the joint of the frame or timbers. The midship timber, or broadest part of the ship, is called dead-flat, and distinguished by this character ⊕. The timbers before the midship are distinguished by the letters A, B, C, &c. and those abaft the midship by the figures 1, 2, 3, &c. Those timbers following dead-flat, both afore and abaft, where there is no rising, are called flats, and are distinguished by the characters (A), (B), &c. in the fore body, and (1), (2), &c. in the after body. It may be generally observed, that all particulars in the fore body are distinguished by letters of the alphabet, and all those in the after body by *figures*. Thus the cant timbers in the fore body are commonly distinguished by a, b, c, &c. and those in the after body by small figures.

As, in all ships of war, there is a fixed height for the lower sill of the midship port above the load-water line, with six months stores, provisions, &c. on board, their capacity should be simply adequate for this purpose, neither more nor less; it should not be more, to avoid superfluous expense in construction and the additional number of men required to navigate; nor should it be less, from an obvious general insufficiency to answer the required purposes; the bias should rather tend to the increase than the diminution of capacity.

If we observe what draught of water a ship draws when she is laden, with every thing on board, and supposed to be immersed to her deep water mark, or load-water line, we shall have only to find a method whereby we may come at the true number of cubic feet contained in the ship below that line; which, consequently, will be the number of cubic feet in the bulk of water displaced by the ship in that position: whence, by calculating the weight of so many cubic feet of water, we may obtain the true weight of the ship with every thing on board, and all that leans or presses upon her.

Now, as ships of the same number of guns and tons, are nearly of the same dimensions, we may, by knowing the weight of such a ship, compare it with the estimated weight of a ship, the plans of which we have constructed, by examining the draught of water, and computing the weight therefrom. If the weight be found to agree with the known weight of that of similar size, the load water line may be considered as rightly placed; and, we shall know, to a certainty, how much water she will draw when brought down to her load-water mark; in consequence, we may determine on the height of the lower-deck ports, by which the true placing of the decks, &c. must be regulated.

But, if the weight, as laid down in the draught, exceeds the weight first mentioned for ships of a similar size, the load-water line in the draught is placed too high, and must be lowered till both the weights are found to agree: for the same reason, if the weight of the ship, in the draught, appears to be less than the weight first mentioned, the water line will then be too low, and must be raised accordingly.

The ship may be laid down in the draught either so as to sail on an even keel or so as to draw most water abaft; but the larger classes, in general, are recommended to be constructed for an even keel, as we have before noticed, having thus the advantage both with respect to strength and velocity. For, if a ship constructed to sail by the stern, be brought down to her load-water mark so as to sail on an even keel, her strength and sailing qualities will be considerably diminished; and, the fore part being brought down lower than it should be, the middle of the ship maintaining its proper depth in the water, the after part must be, by these means, lifted, and will press downwards with a strain which may continue until the ship's sheer is entirely broken. It is probable, that, from this reason, we see so many ships, after having sailed a little while, with broken backs (as it is termed;) that is, with their sheers altered in such a manner, that the sheer rounds up, and the highest part is in midships.

Such are the disadvantages arising from not paying a due attention to those points in the construction of a draught; therefore, when the load water line is found to be situated of a proper height on the draught, according to the weight given, and likewise drawn parallel to the keel, as supposing that to be the best sailing trim, the next matter will be to examine whether the body is constructed suitably thereto, in order to avoid the bad consequences which we have noticed.

For this purpose we must, in the first place, divide the ship equally in two, lengthwise, between the fore and after perpendiculars described on the draught; and, the exact number of cubic feet in the whole bottom beneath the load water line being known, we must find whether the number of cubic feet in each part so divided is the same; if they prove to be so, the body of the ship may then be said to be constructed in all respects suitably to her swimming on an even keel, let the shape of the body be whatever it may, and which will be found to be her natural position at the load water line.

But, if one of the parts should contain a greater number of cubic feet than the other, that part which is the heaviest will sink the deepest, supposing the ship in her natural position. Then, in order to render the ship suitably constructed to the load water line in the draught, (which is parallel to the keel) we must subtract the number of cubic feet contained in the lesser part, from the number contained in the greater part, and then fill out that part of the body which contains the lesser quantity, till it has accumulated half the sum of the difference, and draw in the other part of the body proportionably, so as to make both parts equal. Thus will the ship's body be so constructed as to swim on an even keel.

Also, if we propose that a ship, to be laid down, shall not swim on an even keel, but draw more water abaft than afore, we must then, by comparing the fore and aft parts of the ship's body together, swell out the one part of the body and reduce the other; so that the ship shall have her natural position when brought down to the load water mark, as required.

It has sometimes been supposed that, to construct a draught is no more than to draw the several lines which compose the whole, and form the representation of the sheer draught, half-breadth and body plans at discretion, shaping them in such a manner as only to answer particular purposes, as stowage, dispatch, &c. without the least attention to some considerations which are most essential to every class of shipping. A ship thus constructed, if put together as strongly as possible, and by the most skilful workmen, and likewise with the best materials, would not, unless by mere chance, answer the wished-for purposes so well as one put together in a more unskilful manner, and with more unsound materials, but constructed agreeably to the dictates of theory and experience. Because the latter would always wear easy, by being kept in her natural position and free of compulsion; whereas, on the contrary, the former might, by continual strains, in consequence of her body being irregularly formed, be wearing herself to pieces, and trying every part to the greatest degree; and, by the time that the strength of the latter began to decline, the first would not be in value equal to one half of that of the other ship.

INSTRUCTIONS FOR DELINEATING THE SEVERAL DRAUGHTS AND PLANS OF A SHIP.

GENERAL OBSERVATIONS ON THE PROPORTIONAL DIMENSIONS, &c. PREPARATORY TO THE CONSTRUCTION OF A DRAUGHT.

In order to fix upon the proportions for a ship of any class, it will be necessary, in the first place, to determine on the length between the foremost and after perpendiculars; as, when that determination is once fixed, it becomes a standard whereby all the proportions are calculated, and every particular regulated, with respect to proportion, strength, and beauty.

The proportions will, of course, be regulated upon the principles established by experience. These teach that a ship should not be too long with respect to breadth, nor too short with respect to depth. Length, although highly desirable to a certain degree, if carried to excess, will, as we have shewn, be prejudicial; and, when ships are extremely long, they must have an extraordinary allowance of timber and planking to make them equal in strength to those which are shorter.

The LENGTH BETWEEN THE PERPENDICULARS, in most ships of war, is the length on the gun or lower deck, taken from the aftside of the rabbet of the stem to the foreside of the rabbet of the stern-post at the height of the lower deck: and, in merchant-ships, from the aftside of the stern-post, at the height of the wing transom, to the foreside of the stem at the same height. (See Table of Dimensions and Scantlings, folio I.)

In ships of war the length is regulated by the number of ports intended to be made on the Gun-deck; and the disposition of the timbers by the situation of the ports. The latter should be so disposed as to weaken the ship as little as possible, and so as to avoid cutting off any of the principal timbers, &c. and, in placing them, we must consult the situation of the frames, which is every other bend throughout the ship, and of which the joints are represented by perpendicular lines in the square body, and by ticked lines in the cant bodies, agreeably to their thwartship appearance. (See Sheer Draught, Plate I.)

The foremost and aftermost ports being determined upon, the intermediate ports will be at equal distances asunder, according to the room-and-space; and double the room-and-space must be always sufficient to allow for the breadth of the port, the siding of the frame timbers, and openings between the frame timbers, if any.

The foremost port should be as far forward as circumstances will admit, leaving room for the manger, for the purpose of firing the foremost gun, fore and aft, as a bow chaser. In the seventy-four gun ship the most convenient place will therefore be to place it between the frames U and X, and equally distant from each; it will then be placed in the most superior point of strength, having a long top-timber on the foreside and a long fourth futtock on the aftside of it. The other ports may be placed in like manner, with respect to strength, taking care to have two frames between every two ports, all fore and aft, and they will all be equally spaced; taking care, at the same time, that there shall remain sufficient room for the quarter galleries, clear of the after port.

The foregoing are the first considerations which must take place in the formation of a draught for a ship of war with regard to length. In merchant ships, as having no ports, the disposition of the timbers may, of course, be regulated more simply.

Having fixed the length, the Breadth is the next object to be considered, and this will be regulated by that proportion which is deemed most advantageous for the intended services of the ship; or, by that which has been established by the best practice. The latter may be readily seen by a reference to folio I. of the Table of Dimensions and Scantlings hereafter: or to the draughts which illustrate the present work. By the Table it will be seen, that ships of war, in general, have their moulded breadths about three-elevenths of their length, and merchant ships about three-twelfths excepting cutters and some other smaller vessels.

Depth in Hold is the next dimension to be considered in the construction of the draught. This dimension depends upon the placing of the lower deck, as it is generally taken from the upper side of the lower deck beam in the midships, to the upper side of the strake next the limbers.

The depth in hold in ships of war depends upon the heights of the ports above the water, which should be as high as possible, consistently with the stability of the ship. This is, as we have already shewn, a prime consideration. In line of battle-ships the depth in hold is, generally, about seven-sixteenths of the moulded breadth; and, in frigates, seven-twentieths. In merchant ships it is regulated by the trade they are designed for. Ships, built for the East India trade, in general, have their depth in hold, fourteen feet nine inches; which will admit seven heights of tea, or nine of china.

West India ships have, generally, a depth in hold, of about twelve feet, which enables them, with the deck above, to stow five heights of sugar.

And thus the depth in hold of every merchant ship should be regulated according to the trade she is designed to follow. Her species of merchandize being known, the lower deck should be so placed as to obviate any loss in stowage.

The length, breadth, and depth in hold, being settled, the upper part of the ship is next to be considered. The upper works should be kept as low and as snug as possible, particularly abaft, in order to have a handsome stern. The length of the round house deck must determine the height of the sheer abaft; and the round house should be no longer than is just sufficient for necessary accommodations; for, the shorter the round house the lower will be the works abaft; and a low snug stern is always considered as the handsomest.

The proportioning of the heights afore and abaft is of consequence, inasmuch as it has been universally found that, if a ship be constructed nearly straight, without a proper regard to her sheer, her strength would be proportionably less, and the weight of the extremes would soon cause an alteration in the sheer, by which she might be strained until it would be entirely broken. The quicker the sheer is, the more it contributes to the strength of the ship, and the more room it makes for accommodations with regard to the heights afore and abaft. This property is, however, most suitable to large ships, which carry many officers and require the most accommodations. In small ships, that are built principally for expedition, without a round house, and having few officers, the sheer is, of course, more straight, and kept as snug as possible, or so far as strength will permit.

Of the several heights now to be considered, the first is the proportional height of the top-breadth, or top-timber line, at the lowest place or midships. This may be, for ships of war of three decks, seven-thirtieths of the length; of two decks and under, about one-fifth of the length; and, for merchant ships, five twenty-thirds of the length. The latter, however, being reduced to no fixed rule, will be found to fluctuate accordingly, as may be seen by a reference to the general dimensions.

The HEIGHT of the LOAD-WATER LINE now demands our attention. This may be placed, in three deckers, at twelve twenty-thirds, or little more than one-half of the height of the top-timber line; in two-decked ships, at three-fifths of the top-timber line; and, in other ships, in general, at about five-eighths of the height of the top-timber line, at the lowest place: remembering to set up the height of the load-water line from the underside of the keel.

The height of the lower edge of the wale, and lower height of breadth, in midships, is generally placed at the same height nearly as the load-water line; but we would recommend it to be placed a few inches higher. The lower height of breadth being lifted afore and abaft about the height of the hawse holes forward, and a little above the wing transom abaft, or as the shape of the body may require.

The foregoing are, therefore, the principal points to be attended to in the proportioning of a ship. Other particulars may be varied according to the service for which she is designed. If the depth in hold required be greater than the proportions herein mentioned, it must be gained from the heights between the decks, as it is of the utmost importance to keep the ship, proportionably, as low above water as circumstances will permit.

The WALES are a principal part, and come next under consideration. The Main Wales should be placed on the greatest breadth, that being the part which bears the greatest strain, and so as to be bolted through with the main deck knees, in order to bind and strengthen the deck. Upon the Wales the strength of the ship very much depends; they must, consequently, be so placed, as to be cut or wounded as little as possible by the formation of the ports. The height or sheer of the Wales forward and aft, must be parallel, or nearly so, with the top-timber line.

The Channel Wales are principally intended for the strength of the topside, and must be placed between the lower deck ports and the ports next above. The lower edge of them, in midships, should be placed low as possible, in order to prevent their being cut by the ports fore and abaft, by which we shall find them clear of the ports, excepting, perhaps, two or three of the after ports, which will be of little consequence, as the clamps of the deck next above, on the inside, will make good the deficiency of the wales in that place; and the deck bolts will come in the wales every where else fore and aft.

The same may be said of the Sheer Wales in three decked ships, which come between the middle and upper deck ports.

The Channels are generally so placed that their upper edges may range with the upper edge of the sheer-rail; or so that all the preventer plates shall be placed on the Channel Wales; letting the plates be of such a length that the chain bolt and preventer bolt may come near each edge of the Wale. It must also be observed, that the chains be kept clear of the ports; and, that each of the chains and preventer plates has its proper rake, so as to lie in the true direction of the shrouds.

It now becomes requisite to take some notice of the height of the rising line, or centres of the floor sweeps*; the heights of which, and narrowing or half-breadth of the same, determines the form of the lower part of the body of ships in general, although some constructors form this part of the body without it.

Previous to the determination of the heights of the rising line, we must, of course, determine on the dead-rising, or its height at the midship timber. This will limit its height at that place; and, although, in *Whole Moulding*†, the rising line, all fore and aft, is parallel to the lower height of breadth line, yet, upon better principles, the curve of the rising varies according to the ideas or judgment of the artist, so as to give the lower part of the body of the ship such a figure as theory and experience dictate for the best.

It may here be observed, that the rising line cannot, from its nature, be found by a regular proportional method, from which there can be no variation without impropriety: nor can it be constructed to any fixed proportion unless ships of different classes were built exactly similar to each other; because, the rising line, in ships of war and those which are calculated for velocity, though suitable to the construction of the lower part of each ship, and likely to answer the purpose for which they are designed, cannot be equally proper for ships of the same length and breadth, if required chiefly for burden; as, in the last case, not only the form of the midship bend, but every other part of the bottom, must be on a different plan.

For the Height and Moulded-breadth of the ship at the Wing Transom, we refer the reader to the principal dimensions given in the tables hereafter; being those of ships selected as the best vessels of their respective classes.

We shall now speak of the ornamental parts of construction, &c. and, first, of the head.

* See the article Frames, in the "Explanation of Terms."

† See the article Whole Moulded, in the "Explanation of Terms."

The HEAD of every ship is intended both for ornament and convenience. In the first instance, as an ornament to the structure, the beauty of this part is more admired, and the deformities sooner discovered, than in any other part; for the head is, universally, the object most noticed by the generality of spectators, and many competent judges of naval architecture will assert that the symmetry of the whole depends much on the proportion or disproportion that it bears towards the head. For the appearance of a head, having all its parts well and neatly formed, with a due proportion and harmony between them, strikes the eye of the beholder with admiration; and the head may always be fashioned so as to make it beautiful.

The conveniencies of the head are, to tack the weather clue of the foresail forward, to gammon the bowsprit, to water the provisions, and as a seat of ease. With regard to tacking of the foresail forward, the head is of principal use, as also to trim the sail to the wind, so that the lee-leech may not bag, and oppose the motion of the ship; it may therefore be inferred, that short heads are not proper, because they require the boomkins at their outer ends to be in distance from the foremast, so as to plumb with the fore yard arm, when braced sharp, for the tacking of the sail forward.

The heads of all ships should be, as much as each class will admit, proportionably light and airy. In ships having three decks, the form of the head and rails will be most disproportionable. But, in order to help the same as much as possible, the length of the head must be so much longer than has been usual, which will take off something from the great depth. But, as heads in general, particularly long heads, are a great overweight to the ship, we would recommend the figure, or carved work, to be as light as possible; and, the means whereby we may take off more will be, to let the distance between the cheeks be more than has been general. Therefore, let the distance from the lower edge of the lower cheek at the stem, to the lower edge of the cheek on the stem, be three-fourths of the distance from the lower edge of the lower cheek to the lower edge of the main rail at the stem. The lower cheek must be kept well, or nearly so, on the upper strake of the main wales, in consequence of the hawse holes coming between the cheeks, which are on the lower deck. The main rail, also, keeping it as low and level as is possible in the bag or curvature, for the convenience of the gratings, cannot be any lower than the surface of the upper deck. The intermediate rails between the upper cheek and main rail may be equally spaced at every head timber, observing to let one of the middle rails form a curve with the supporter of the cat head, which may best clear the bow-port. The best supporters under the catheads are knees, the side arm of which must stand perpendicularly, or nearly so.

The timbers of the head, which support the rails, and keep them together, are always three, and sometimes four, afore the stem, and one abaft it (in large ships). The foremost head timber should be placed so as to range with the heel of the figure; one should be placed, its siding before the stem (termed the stem-timber) the other timbers exactly in the middle between; and that abaft the stem may be at the same distance from the stem timber as those afore it. Seventy-four gun ships, having only two decks, and, in consequence thereof having a snug top-side, it is so much the easier to form, for these ships, a handsome and proportional head. Therefore, the situation of the hawse-holes may here determine the position of the upper edge of the lower cheek.

The main rail in the bag, and in wake of the stem, should be on a level with the upper part of the beakhead; and, if convenient, the upper cheek at the stem may be exactly in the middle between the main rail and lower cheek. The remaining parts may be formed according to fancy, only observing always to keep the fore part of the rails and head well up, so as to form an agreeable flight to the sheer of the ship, and, as the spacing of the rails, the number of them, and likewise the stem-timbers, are just the same as before described, it will be unnecessary to give any farther detail of them here.

Sixty-four and fifty gun ships. This class has not so snug a topside as the last, for the number of guns being considerably less, the length of the ship is consequently less, in proportion. But the guns, by being carried upon two decks, make these ships require a topside almost as high as the former class, by which they are much higher in proportion to the length than the ships above-mentioned; however, in order to make the head appear as handsome as possible, keep the cheeks as high as circumstances will admit. Therefore, let the upper edge of the lower cheek be kept up so as to have bolsters of a substance of only five inches under the hawse-holes. The main rail in the bag, and in wake of the stem, should be on a level with the upperside of the beak-head, which should never be higher than to range with the upper-side of the lower sills of the upper deck ports above the deck. The upper cheek at the stem is to be placed in the middle between the lower cheek and main rail.

Forty gun frigates and vessels carrying their guns upon one deck, afford the fairest opportunity of forming a handsome head and set of rails, by reason of a snug and shallow topside; in consequence of which, we must keep the rails and cheeks pretty close; and, by throwing the fore-part of the rails and figure well up, we shall have a light airy head, which will always appear well out of water.

Let the upper edge of the upper cheek, at the stem, be just sufficient to have about four inches whole wood of bolster under the hawse-holes, on the foreside, to keep the rub of the cables from the cheeks; for, in this class of ships the hawse-holes are above the upper cheek, and the cheeks may be kept about one foot ten inches asunder. In lesser ships at the stem, one foot four inches.

Let the distance from the upper edge of the upper cheek to the upper edge of the main rail at the stem, be the same as the distance from the upper edge of the lower cheek to the upper edge of the upper cheek. There is only one rail between the upper cheek and main rail, equally spaced between, the after end of it breaking in with a fair curve to the supporter of the cathead. The timbers, &c. similar to the foregoing.

The heads of merchant ships, in general, may be considered under this class: and what has been just directed will be the most applicable thereto.

The knightheads, or bollard timbers, must run sufficiently high, above the bowsprit, to admit of a chock coming between them for the better security of the bowsprit. The timber heads, along the forecastle, should always be so conveniently placed that the timbers of the frame may correspond, which will be those timbers that come over the upper deck ports; so that they may be allowed long enough to form handsome heads. This must be particularly attended to in those ships which have had, according to recent practice, timbers to run up high enough to take a rough tree rail round the bow. There should be one timber head placed close afore the cat-head for the cat-block to bolt to, and the after part of the main rail of the head, is to bolt to that timber likewise. There should also be two or three ports, on each side of the forecastle, formed by the timber heads; placing the ports where they may be most convenient to be clear of the shrouds.

Lastly, the fore part of the knee of the head may be formed by a handsome serpentine line, observing, in forming of it downwards, not to let it be too full; as, in that case, it will not only look clumsy, but will always be liable to rub the cable very much. It should, therefore, have no more substance under the lower cheek at the heel of the figure, than is just sufficient to admit of the bobstay holes. As a further prevention, let the foreside be well rounded.

The STERNS of all ships should be kept as low and as snug as possible, consistently with the size and force of the ship; the stern, being terminated above by the taffarel, and below by the counters, and being limited on the sides by the quarter-pieces, comprehends in the intermediate space, in large ships, the ward-room lights and galleries; and, in small ships, the great cabin windows only.

What has been said, with regard to the beauty and utility of the head, may, in some measure, be applied to the stern; the beauty of the stern being the grand ornament to the after part of the ship. In order to produce one that shall be handsome, the counter-rails must have a handsome round-up and round-aft, which will produce a light and airy appearance. Each rail continuing to have more round-up in proceeding upwards.

The sterns of large ships in the Royal Navy have lately had no open balcony; but, like those of some East India ships, have been wholly inclosed, which makes them very snug, and adds considerably to the strength of the stern. The timbers running all the way up give at the same time, a better opportunity for forming the ports more advantageously to fight the guns right-aft.

If a stern be unavoidably deep, the lower and second counters must be made deep in proportion. The lights less in number and deep also; and some light carved work or device should be formed between the head of the lights and taffarel, because the latter would otherwise appear too deep, as a single stern will always appear on a near view much better than an artificial double one.

The knuckles of the counters must be so disposed that the lower and second counter shall be in proportion to the whole of the stern.

The heights of the decks must be next considered; for sometimes, in order to give depth for the lights, the decks are necessarily sprung abaft, and their round-up must be made conformably thereto.

The QUARTER-GALLERIES. The heights of the Quarter-Galleries depend upon the stern; but, to make them handsome, the lower-rim should be as long as possible, and may spread within a few inches, if necessary, of the main-breadth amidships; for, as the whole quarter must be regulated by the lower rim, if that is short or stunted, the whole quarter-gallery will appear cramped.

Every thing relative to the head and stern being now sufficiently described, we may proceed to the RUDDER, which must be particularly considered, as many of the qualities required in a ship depend in a great measure upon the rudder; therefore, we must first determine on the breadth of it at the heel, or lower end, with the back included, which may be one-eighth of the moulded breadth, for ships in the navy in general. But, for merchant ships, or those constructed chiefly for burden, it may be one-seventh. The breadth at the heel being determined, the height of the lower hance may be fixed at about one-foot above the load-water line, and its breadth there should be three-fourths of the breadth at the heel, for ships in the navy, and two-thirds only for merchant ships in general. There may also be another hance at about the height of the lower deck. The use of the breaks or hances is, merely to reduce the breadth as it rises towards the head, the greatest breadth being only required below the water, where it feels the motion of the ship.

The rudder being more impelled by the water at the height of the floating-line than at the keel, since the fluid exactly follows the outlines of the bottom, some constructors, particularly the French, have been induced to make the rudder broader towards the load-water line and narrower towards the keel. See the Table of Dimensions and Scantlings hereafter.

The most advantageous angle that the rudder can be placed in, when it be required to turn the ship, is allowed to be at forty-five degrees with the line of the keel prolonged; but the general practice is, to beard its fore-side to two-fifths of its thickness each way from the middle line.

It has been customary to beard the rudder to a sharp edge at the middle line, by which the main-piece is reduced more than necessary, as is readily perceived in large ships; for we may observe that, when the rudder is put hard over, the bearding will not touch the stern-post by nearly an inch; to obviate which, the rudder should be bearded from the side of the pintles, and the foreside made to the form of the pintles. Again, as the upper pintle has always wounded the main-piece of the rudder so much with this mode of bearding it, let the aftside of the stern-post be bearded or tapered about one-fourth of its thickness, athwartships, and then the rudder will be bearded so much the less. This, also, will greatly assist the conversion of the stern-post.

It is proper here to notice an improvement in the rudder, which has taken place within these few years, and has been adopted in many ships, particularly in most of those in the service of the East India Company. It will, however, be requisite previously to describe the usual form of the rudder, in order to shew the advantages of the new method.

In the Sheer Draught of the seventy-four gun ship, (Plate I.) the rudder is represented according to the common method of construction; in which, the centre of the pintles, that are parallel to the aftside of the stern-post, is the axis of rotation. It is hence evident, that a space considerably greater than the transverse section of the rudder at the counter, must be left in the counter for the rudder to revolve in. The figure abaft the wing transom, in the sheer plan, which is a section of the rudder at the counter, shews that there must be a space in the counter similar to that round the rudder in the section, in order that the rudder may be moveable as required.

Hence, to prevent the water from washing up the helm port, or rudder hole, a rudder coat, that is, a piece of tarred canvass, is nailed in such a manner, to the rudder and counter, as to cover the intermediate space: but the canvass being continually washed by the sea, soon becomes brittle, and unable to yield to the various turns of the rudder without breaking; in which case, the ship is of course left pervious to the waves, even of three or four feet high; in fact, there are few men bred to the sea who have not been witnesses to the bad effects of such a space being left so ill guarded against the stroke of the waves; and many ships have been supposed to founder at sea from the quantity of water shipped between the rudder and the counter.

It was to remedy this defect, that the alteration above alluded to took place; which consists in making the upper part of the rudder cylindrical, and giving that part at the same time a cast forward, as may be clearly seen in the Profile of Inboard Works, Plate IV; so that the axis of rotation may thus be represented by the ticked line, passing, as usual, through the centres of the pintles which attach the rudder to the stern-post, and thence to the head, through the axis of that cylindrical part; in order that the transverse section of the rudder at the counter may be a circle revolving upon its centre. In this case, the space between the rudder and the counter need be no more than just sufficient to hang it; and, consequently, the necessity of a rudder coat is done away. But, as it was foreseen, that, if the rudder by any accident was unshipped, this alteration might endanger the tearing away of the counter, the hole is made somewhat larger than the transverse section of the cylindric part of the rudder, and the space between covered over with a rim of wood fitted to the counter, so as to be capable of withstanding the shock of the sea, but to be easily carried away with the rudder, leaving the counter, under such circumstances, in as safe a state as it would be in, according to the present mode of making rudders in the navy. Again, the rudder, being cylindrical in that part, the wooden rim is fitted nearly close; but, to prevent the least water from entering the ship, a leathern hose is fitted as closely as possible.

The Centres or Places of the Masts, upon the gun or lower deck, may be determined upon thus: the foremast may be about one-ninth of the length between the perpendiculars abaft the foremost perpendicular, for ships in the navy, and two-thirteenths in merchant ships. The centre of the main-mast to be five-ninths of the length abaft the foremost perpendicular for all ships in general, and the mizen-mast in large ships four twenty-fifths of the length afore the after perpendicular; and, in smaller ships, as frigates, &c. four twenty-sixths.

For Brigs, or vessels with two masts, the fore-mast to be one-eighth of the said length abaft the foremost perpendicular; that is to say, in sharp vessels; but, in full vessels, as the Colliers, &c. it is to be about one-seventh. The main-mast to be three-fifths of the length abaft the foremost perpendicular.

But Cutters, and one masted vessels in general, have the centre of the mast about one-third of the length from forward.

OF THE CONSTRUCTION OF THE SHEER DRAUGHT OF THE SEVENTY-FOUR GUN SHIP, FROM THE GIVEN DIMENSIONS.

The first thing to be determined upon is the length on the gundeck, or distance between the fore and after perpendiculars, which is, as given in the table of dimensions, 176 feet. Draw, therefore, a straight line on the paper, representing the upper edge of the rabbet of the keel, taking care to let it be at a sufficient distance from the lower edge of the paper to admit of the scale and the half breadth plan beneath. Erect the perpendicular, named the foremost perpendicular, on that end to the right, (allowing sufficient space on the paper for the projection of the head and rails); thence set off 176 feet, the length of the gundeck, and there erect the after perpendicular. Then draw the scale of feet and inches, numbering it as marked on the Sheer Draught.

The stem now may be formed; in order to which, the centre for sweeping the stem, taken from the table of dimensions, must be set off thus: fix one leg of the compasses in that centre, and the other in the line of the upper edge of the rabbet of the keel; thence describe a segment of a circle upwards towards the foremost perpendicular, and then, from the same centre, describe another circle beyond the former, as much as the stem is moulded. Another circle must now be drawn, from the same centre, before the inside of the stem to, and parallel with, the thickness of the bottom plank. Then set up the height of the head of the stem from the dimensions, and its distance before the foremost perpendicular; make a spot, and abaft that, set off the mouldings of the stem, and there make another spot; from the last mentioned spot let a curve line pass downwards, breaking fair into the sweep of the stem by which the aft-side of the stem is drawn; then, by letting another curve line pass from the foremost spot at the head of the stem downwards, parallel to the aft-side, breaking in fair with the outer circle, the whole stem will be formed, excepting the after or lower end, which cannot be determined upon till hereafter.

The stern-post may next be drawn, thus; set up from the dimensions, above the upper edge of the rabbet of the keel, the height of the wing-transom at the after perpendicular; there draw a horizontal line, and then draw another line parallel with and below it, to the margin or lower side of the tuck rail, upon which set off a spot for the aft part of the rabbet of the post, taken from the dimensions, and thence another spot may be taken. Set off upon the upper edge of the keel, a line drawn to intersect those spots; which will represent the aftside of the rabbet, then, a parallel line drawn before that, to the thickness of the bottom plank, will intersect the after perpendicular at the height of the lower deck; and, where this foreside of the rabbet intersects the horizontal line is the aftside of the wing-transom. From the aftside of the rabbet, on the horizontal line, set aft the distance of the aftside of the stern-post, and likewise set aft the distance of the aftside of the stern-post from the rabbet on the upper edge of the keel, both taken from the dimensions; then, a straight line drawn to intersect those spots will shew the aftside of the stern-post. Thus will the stern-post be described for the present, as the head will not be determined till hereafter.

Next proceed to set aft the distance of dead-flat from the foremost perpendicular; and, at that place, erect a third perpendicular, which is distinguished by the character ⊕; the broadest and fullest part of the ship, and termed the midship bend. From dead-flat the stations of all the timbers must be set off; but it will be only necessary to erect a perpendicular at every frame timber, (omitting the fillings,) which are in the fore body called dead-flat, B, D, F, &c. and in the after body (2), 2, 4, &c. and the distance between the frame perpendiculars will thus be double the room and space given in the dimensions.

Then proceed to set up the heights; all of which must be done from the line representing the upper edge of the rabbet of the keel. First set up the heights of the lower deck at the three perpendiculars, afore, in midships, (or at dead-flat,) and abaft; then, by moulds which are portions of the circles, (termed sweeps,) or a bow, draw a curve line through these three heights, and the upperside of the gun-deck will be formed. Now, setting off the thickness of the gun-deck plank below the curve last drawn, let another line be drawn parallel thereto, and the gun-deck will be described, as at the middle line in the sheer-plan.

Next proceed to draw the upper deck in; set up three heights between the gun and upper deck, (afore, amidships, and abaft,) taken from the dimensions, through which heights draw a curve; then set up the thickness of the deck, and draw another curve, parallel to the former; the upper deck will then be represented at the middle line of the sheer-plan.

The stern-timbers should next be drawn. Set up the height of the lower counter at the middle line, from the upper edge of the rabbet of the keel, and draw an horizontal line in pencil; on this horizontal line set aft the distance which the knuckle of the lower counter is abaft the after perpendicular, taken from the dimensions; then make a spot, from which spot, to where the fore-part of the rabbet of the stern-post intersects the line drawn for the upperside of the wing-transom, draw a curve to the hollow of the lower counter; which curve will represent the lower counter at the middle line.

Then set up the height of the upper counter, at the middle line, from the upper edge of the rabbet of the keel, and draw an horizontal line as before; thereon set aft the distance which the knuckle of the upper counter is abaft the after perpendicular; then, drawing a curve thence to the knuckle of the lower counter, the upper counter will likewise be described at the middle line.

Having the upper and lower counters drawn at the middle line, the upper part of the stern-timber above the counters must be drawn as follows:

Set up, above the upper edge of the rabbet of the keel, the height of the upper part of the taffarel, from the dimensions; there draw an horizontal line; and set aft thereon the distance of the stern-timber from the after perpendicular; make a spot, and then, drawing a straight line from the knuckle of the upper counter, to pass through the said spot, the upper part of the stern-timber will be drawn, by which the rake of the stern will be described.

As the stern rounds two ways, both up and aft, (or forward from the timber already drawn,) the stern-timber at the side will consequently alter from that at the middle line, and therefore remains to be represented. Take, from the dimensions, how much the upper counter rounds up, and set it below its respective knuckle at the middle, drawing a horizontal line in pencil; then take how much it rounds aft, and set it forward from the knuckle on the horizontal line first drawn; square it down to the line last drawn, in pencil, and where it intersects make a spot, which will be the knuckle of the upper counter at the side. Then proceeding, in like manner, with the lower counter, the knuckle for the lower counter at the side will be produced; and, by drawing a curve from the knuckles at the side, (similar to the curve or hollow at the middle line,) the upper counter at the side will be also formed.

To draw the lower counter at the side.—Take the round-up of the wing-transom, from the dimensions, and set it off below the horizontal line before drawn for the height of the wing-transom; and there draw another horizontal line in pencil. Now, take the round-aft of the wing-transom; set it forward, on the upper line, from the aftside of the wing-transom; then squaring it down to the lower line, the intersection will be the touch of the wing-transom at the side. Again, by drawing a curve (similar to the curve or hollow at the middle line,) from the knuckle of the lower counter at the side to the touch of the wing-transom, the form of the lower counter at the side will be formed.

The upper part of the side stern-timber only now remains to be drawn to complete it. But, as a straight line, which must be drawn for the upper part of the side-timber, should not be parallel to that at the middle line, the following method will determine the exact rake thereof. Draw a straight line, at pleasure, on which set off the breadth of the stern at the upper counter; then, at the middle of that breadth set off the round-aft of the upper counter; draw a curve or portion of a circle that shall intersect the spot set off at the middle and the spots at the breadth, and the round-aft of the stern will be described at any part of its breadth above the upper counter: thus, take the breadth of the stern at the top-timber line, from the dimensions, and set it off equally on each side the middle to where it shall intersect the round-aft; thence draw a line, parallel to that first drawn, and the distance between the line last drawn to the curve at the middle, is the distance that the side-timber will be from the middle-timber, on a horizontal line, at the height of the top-timber line.

The rake of the stern-timbers being determined, proceed to finish the decks, by drawing in the quarter deck and forecastle; which may be done by taking their respective heights and lengths from the dimensions, and drawing their curves. In the same manner may the round-house deck be drawn.

All the decks having been drawn in, representing their heights at the middle, we must now proceed to draw their heights at the side. To do which correctly, take the round-up of the beam of its respective deck from the table of dimensions, and set it up in the middle of a line drawn at pleasure: then, on each side of the middle of this line, set off the half-breadth at dead-flat, or the broadest place, taken at the height of the deck. Then raise an arc, that shall intersect the round-up set off at the middle, with the spots at the breadth, and the round-up of the deck will be described at any part of its breadth. Thus, take the half-breadth at the height of the deck at any timber, in the body-plan, and set it off equally from the middle of the round-up till it intersects the curve; whence draw a line parallel to that first drawn, and the distance between the line last drawn to the round-up curve in the middle, is what the beam rounds at that place. Thus may the round-up be taken at as many timbers as may be found necessary, and set below the underside of the deck at its respective timber in the sheer-plan; then, a curve line passing through those spots will represent the deck at the side: but observe, that the decks are to have a sufficient round abaft, to correspond with the round-up of the stern above the lights.

The sheer or top-timber line may now be drawn; which is done, by taking its heights from the table of the dimensions of bodies, and setting them up in the sheer-plan at its respective timbers: then, by drawing a curve through those spots, the sheer of the ship or top-timber line will be represented.

The ports may next be drawn, thus: draw two curves, in pencil, fore and aft, for the lower and upper parts of the lower-deck ports, by taking from the table of dimensions their depths and heights from the deck; drawing the two curves parallel to the deck at the side, and observing to add the thickness of the deck; as the line for the deck at the side represents the underside of the deck, or upperside of the beam.

The fore sides and aft sides of the ports may next be squared up between the two lines last drawn; placing the foremost port and after port agreeably to the distance given in the dimensions, as also the intermediate ones.

In the same manner may the upper-deck ports be drawn; observing to place them agreeably to the dimensions: those on the quarter-deck and forecastle must be placed where there is a vacancy between the dead-eyes to admit of them, observing to place them as nearly as possible at equal distances.

The round-house deck being drawn, let a line be drawn parallel to the top-timber line, that shall touch the round-house deck at the side, at the fore part, and continue thence quite aft: above which, set up the thickness of the planksheer, and draw another line parallel to the former; so will the extreme height of the topside be described abaft; which height continues to range fair along to the fore end of the round-house, where it finishes with an inverted scroll upon the planksheer, that completes the height of the side along the fore part of the quarter-deck, which is, in the seventy-four gun ship, three feet nine inches above the top-timber line and parallel thereto. The planksheer turns off with a round, abreast the main-mast, to unite with the planksheer at the main drift, which is three feet one inch above, and parallel to, the top-timber line, and turns off with an inverted scroll upon the drift-rail at the gangway.

The drift-rail may now be drawn, it being thirteen inches below the underside of the planksheer at the main drift, and finishes with a scroll upon the sheer-rail at the gangway; then rises with a scroll abreast the main-mast, where it is kept to the same distance below the planksheer, and thence continued parallel to the top-timber line quite aft. These lines being drawn, they represent the upper edges of the rails which are put on to embellish that part of the ship.

We may next proceed to the fore part of the ship, in order to delineate the height of the topside there. Let the break be at the after-end of the forecastle, and turned off with a scroll, as at the fore part of the quarter-deck, drawing the lines of the fore drift-rail and planksheer to the heights given above the top-timber line in the dimensions, and parallel thereto.

The upper part of the ship being thus far complete, we have at one view the utmost extent of the sheer, as seen on a plane.

It now remains to represent the finishing parts, as the wales, stern, head, rails, &c.

Proceed to take the heights and breadth of the main-wale afore, amidships, and abaft, from the table of dimensions, and draw in their curves, by which the main-wale will be represented.

Next draw in the channel-wale, taking its heights and breadth from the table of dimensions; then draw curves through the spots as with the main-wale, and they will be represented.

The waist-rail may be next drawn. Its distance below the top-timber line may be taken from the table of dimensions, and kept parallel thereto, all fore and aft.

Now, from the Table of Bodies, set up the lower and upper heights of breadth, upon their corresponding timbers in the sheer-plan, and draw curves through the spots so found, which will represent the lower and upper heights of breadth of the ship.

Then take the draught of water from the table of dimensions, and draw in the load-water line, which is always done in green ink: draw in, likewise, between that and the upper edge of the rabbet of the keel, four or more water lines, at equal distances between.

In the next place, the centres of the masts may be set off on the gun-deck, taken from the table of dimensions, and the rake of them likewise. The centre of the bowsprit and its stive may likewise be taken from the dimensions, set off, and the bowsprit drawn in.

The timber-heads may now be drawn in above the planksheer of the forecastle, and the starboard knight-head drawn in agreeably to its height, &c.

Now draw in the channels, taking their length and thicknesses from the dimensions, placing their upper edges, next the side, in a line with the upper edge of the sheer-rail. The dead-eyes may then be drawn, observing to place them in such a manner that the chains may not interfere with the ports. All the preventer plates must be placed on the channel-wales, and of such a length, that the chain and preventer bolt may come on each edge of the channel-wales. It must also be observed to give each of the chains and preventer plates a proper rake; that is, to let them lie in the direction of the shrouds; which may be done in the following manner: draw a line upwards for the centre of the mast, upon which set off the length to the lower part of its head; then, by drawing straight lines from that height, through the centre of each dead-eye, the direction of each chain will be obtained by the direction of its corresponding line.

In the next place, let us see that the fore channel is long enough to take the anchor-lining and bill-board for stowing the anchor, thus: get the length of the anchor to the bill, and allow for the cat-block; then sweep the distance so obtained from the cat-head aft, and the curve that the bill of the anchor is supposed to make will give the middle of the lining: the aftside from the channel may be perpendicular, and the fore-part follow the curve made by the anchor. The bill-board may then be carried upwards from the upperside of the channel to the top of the side. The anchor lining commences at the upperside of the bolster, which, in the eighty-gun ship, may be well with the upperside of the channel-wale, and long enough, at the fore-part, for a man to stand upon.

After finishing the dead-eyes and channels, the fenders may be drawn; observing to place them right abreast of the main hatchway, for the purpose of preventing the ship's side from being hurt by whatever may be hoisted on board. The distance between them may be governed by the distance between the ports, placing them asunder as the upper and lower deck ports afford an interval *. The chestree must also be placed, for hauling home the main-tack, half the length of the main-yard before the centre of the main-mast, and drawn in from the top of the side down to the upper edge of the channel-wales. The fenders may reach from the top of the side down to the upper edge of the main-wales; and, as the fenders and chestree come on the outside of the planks, wales, &c. they must be so represented, by not letting the rails, wales, &c. run through them.

Proceed to draw in the steps on the side, which must be placed at the fore part of the main-drift, or gangway, about three feet in length, six inches asunder, and five inches deep, from the top of the side down to the load-water line.

Having formed the sheer-plan thus far, we may proceed to the finishing and ornamental parts, which are the Head and Stern. First draw in the Head, by first setting up the height of the beak-head, which should be of the same height as the upperside of the port sills, or lower sides of the ports above the deck; at which height draw an horizontal line; upon this line set aft the length of the beak-head abaft the fore part of the stem, as in the dimensions; thence square up a line to the forecastle, which line will represent the fore part of the beak-head, and will likewise determine the foremost end of the forecastle. The length of the head may now be set off from the fore part of the stem, as in the dimensions; and there erect a perpendicular, which will be the utmost limits of the figure forward; then, from the dimensions, take what the figure is fore and aft, and setting it off abaft the perpendicular last mentioned, another perpendicular may be erected, which will shew the utmost extent of the hair-bracket forward, or the aft part of the figure.

In the next place, draw in the cheeks, taking their heights and sidings from the dimensions; then draw curves to rise fair with the sheer of the wale, lifting gracefully forward. The lower side of the lower cheek breaks in fair with the foremost perpendicular of the figure, and the lower side of the upper cheek breaks in fair with the perpendicular at the back of the figure, and forms the foreside of the hair-bracket †. The upper sides of the cheeks may now be drawn in; and, as they taper all their length, may be regularly diminished. Set off from their after ends (which are squared up from the main half-breadth line) a number of equal divisions, suppose each to be two feet, quite forward to the foremost end, and each division regularly numbered; then draw a straight line, at plea-

* Fenders are now not used in the navy as they only rot the side.

† The Hair-Bracket extends from the scroll down to the heel of the foremost head-timber.

sure, upon which set off the same number of equal divisions. Having done this, set off, at the after end and foremost end, the siding or depth of the cheek; through the spots which distinguish this draw another straight line; then, at each division, take its tapering, and set it off at its respective division above the line already drawn on the sheer-plan. A curve drawn through the last-mentioned spots will represent the upper sides of the cheeks; observing, that the upperside of the lower cheek stops at a perpendicular line let fall from the heel of the foremost head-timber. The upperside of the upper cheek runs in a handsome serpentine line as high as where the shoulder of the figure is supposed to come; at which place it is turned off with a scroll.

The head of the figure, or block, may be formed, by continuing the line from the breast of the figure to the top of the hair-bracket, observing to keep the top of it from four to six inches clear of the underside of the bowsprit.

Now take the height of the upperside of the main-rail from the dimensions, and proceed to draw it in; keeping the bag of it as level as possible, for the convenience of the gratings, and letting the foremost end rise gradually, accordingly to the rise of the upper cheek and hairbracket. Then, to form the after end, set off the moulding of the head of the rail abaft the beak-head line, and erect a perpendicular; then draw in a curve from that perpendicular, to break in fair with the lowerside of the main-rail in the middle, and likewise another from the beak-head perpendicular, to break in fair with the upperside of the rail at the middle. The main-rail may then be completely formed, observing the rule given for diminishing the cheeks, by which the rails and cheeks will appear with a regular taper. Observe to let the head of the main-rail run up sufficiently high to range with the timber-heads above the forecastle, or higher, that many turns may be taken by the anchor-stopper.

The head-timbers must next be drawn, placing the stern-timber perpendicularly its thickness from the stem, and the foreside of the foremost timber to stand perpendicularly over the heel of the block or figure; but, if it rakes forward at the upper part, it will produce lightness of appearance in the head. From the length of the figure, as taken from the dimensions, a perpendicular may be erected, from the lower part of the lower cheek to the lower part of the upper cheek; which perpendicular will terminate the foremost end of the lower cheek and lower end of the hair-bracket, as before observed. The thickness of the stem-timber, and also the foremost one, may be then drawn in, and the head-timbers between them equally spaced. Then another timber may be placed abaft the stem, at the same distance abaft the stem-timber as that between the others, and the lower end of it may step on the upper edge of the lower rail.

The head-timbers being drawn, proceed to draw in the middle and lower rail; which may be done by dividing the space between the lower part of the main-rail and the upper part of the upper cheek, equally at every head-timber; and drawing curves to pass through those spots, the middle and lower rail may be formed, letting the after end of the lower rail terminate where it touches the side.

The cat-head may next be drawn, letting it project from the aftside of the head of the main-rail, to rake forward about four inches in every foot without board, or stand square with the bow, and to stive upwards about five inches and a half in a foot; observing that the lower part comes on the plank of the deck at the side; and the supporter under it must form a fair curve, to break in with the after end of the middle-rail.

The hawse-holes in ships of this class come between the cheeks, but their exact situation in the Sheer-plan cannot be determined on, till we have them represented on the half-breadth plan, as shewn hereafter.

The knee of the head may now be drawn, letting it project from the breast of the figure about four inches; thence draw the fore-part of the knee, with an agreeable serpentine line, to its thickness from the stem about six feet below the load-water line; then, by continuing the same line downwards, and by drawing it more distant from the stem as it comes down, the gripe may be formed agreeably to the dimensions, letting the lower part break in fair with the under part of the false-keel. As the aft part of the gripe is terminated by the fore foot, or foremost end of the keel, it may now be drawn in likewise.

From the line representing the upper edge of the keel, set down the depth of the keel from the dimensions, and draw a line parallel to the former, all fore and aft; which will represent the lower part of the keel. Then, where the inner sweep of the stem rises above the line for the upper edge of the keel, as high as the keel is deep, erect a perpendicular from the lower part of the latter up to the fore-side of the stem, and thence let it be squared from the foreside to the aftside of the stem; by which the foremost end of the keel will be represented; and the boxing, or lower end of the stem, may be drawn, by setting aft the length of the scarph from the foremost end of the keel, and dropping a perpendicular there about half the depth of the keel. Continue thence forward a line parallel to the lower part of the keel for about one-third of the length of the scarph, where it will meet the foreside of the stem, and complete it.

Then set off below the line representing the lower edge of the keel, the thickness of the false keel; and, drawing a line fore and aft, parallel to the former, the false keel will be represented; the foremost end of which may be three inches afore the foremost end of the main-keel.

Having now explained every thing relative to the head, with respect to the sheer-draught, we shall proceed to the stern, and make a few observations, which will suffice for the present, as the stern will be more particularly and fully treated of hereafter in the laying it off in the mould-loft.

The side and middle timbers of the stern being already drawn, set off from the side stern-timber the length of the lower-gallery rim forward, and then draw a line, in pencil, parallel to the side counter-timber, from the knuckle of the second counter upwards, which gives the length of the lower gallery. Then, to represent the lower-gallery rim, upon the sheer-plan, the perpendicular plan of the stern must be designed, as exhibited in Plate I.

Draw in the plan of the stern, as on Plates I. and II., a horizontal line, at the height of the upperside of the wing-transom, of the knuckles of the upper and lower counters, and at the top-timber line, at the side-timber, taken from the sheer-plan, and set off the half-breadths of the stern-timber on each side of the middle line in the plan of the stern upon its respective heights: then set off the scantling of the timber and describe the inside of the stern-timber.

The stern-timbers being shewn in the perpendicular plan of the stern, take the heights from the line C D, at the upperside of the wing-transom in the sheer-plan, to the knuckle of the lower and upper counters at the midship timber, and set them up the middle line, above its corresponding line C D, in the perpendicular plan of the stern. Then sweep curves to intersect the height at the middle line; and, at the half-breadth of the timber on the horizontal lines; and they will represent the knuckles of all the counter timbers in the perpendicular plan of the stern.

Proceed now to lay down the upper and lower counter rails, in the plan of the stern, thus: at the knuckle of the upper and lower counter of the midship timber, in the sheer-plan, square aft a line from its respective counter; then, from the knuckle on the square line set off the thickness of the counter plank, and take that height at its respective counter on a perpendicular from the line C D; then transfer them up the middle line, from the line C D, in the perpendicular plan of the stern; and, above those heights, set up the moulding or depth of the rails and sweep curves to intersect those spots, parallel to the ticked curve, or knuckles of the timbers sweeping them far enough beyond the timbers for the outside of the gallery.

Then take the height of the underside of the quarter deck at the midship stern-timber in the sheer-plan, above the line C D on a perpendicular, and set it up the middle line above the line C D in the perpendicular plan of the stern; next take that height from the upperside of the upper counter rail, and set it off above the upperside of the upper counter rail at, and in the direction of, the side stern-timbers, in the perpendicular plan of the stern; now sweep a curve which shall intersect those spots, and this will give an agreeable round-up to the quarter deck transom. (The after beams of the quarter deck must be gradually sprung to answer thereto.) Sweep another curve, parallel to the quarter deck, to represent the underside of the transom; and another at least one inch and a quarter below it, to allow for the joiner's roofing, and that may be the upper part of the lights.

Set off, withinside the stern-timbers in the horizontal plan of the stern, the thickness of the quarter deck clamps and projection of the cornice under the beams in the cabin, and that shall be the side of the lights next the side. Then determine on the breadth of the munions, which may be about fourteen inches, upon the upper counter rail, and divide them across the stern so as to make six equal lights between the side stern-timbers. Next, continue upwards the middle line in the plan of the stern, and the side stern-timbers above the upper counter rail till each unite in one centre at the middle line, and call it the centre of the stern; then fix a line, or batten, to that centre, and strike down all the sides of the munions as set off upon the upperside of the upper counter-rail. On each side of the munions about one inch and a quarter will now represent the width of the sashes in the clear.

In order to have a well proportioned depth to the sashes, take the width in the clear at bottom, and set it up the side, and take the hypothenuse or distance from the width set up to the width at the bottom on the opposite side, and set it off up the rake of the stern-timber, in the sheer-plan, which gives the depth of the lights in the clear: then take that height upon a perpendicular from the line C D, and set it off above the line C D in the plan of the stern, and sweep a parallel curve to the underside of the quarter deck transom.

Now, it is very evident, that, owing to the tumble-home of the side stern-timbers, the munions and appearance of the sashes in the clear will be narrower at the upper part than at the bottom, but the outsides of the sashes must be of a parallel breadth or they cannot slide; therefore the side stiles will not be parallel, but broadest at top, which is hidden by the munions when the sashes are in their places.

It may, however, be observed that, in sterns of frigates, or when the sashes slide upwards, rabbets must be taken out of the aftsides of the counter timbers to make room for the pully pieces and pullies. Springs would wound the timbers less, but cannot be recommended, because so liable to be out of order.

Set off the mock light in the aft part of the quarter gallery, of the same size as the other lights; and, at about half the breadth of the munions from the mock light, fix the inside of the quarter piece; then, set off the breadth of the quarter piece at the heel, the outside of which determines the outer ends of the upper counter rail in the plan of the stern: next represent the chamfer necessary for the mouldings on the outer ends of the rails; and, within that, at the under edge, set off the thickness of the birthing of the quarters, which will give the knuckles of the quarter timbers at the outside of the gallery; then strike a straight line, from the knuckle under the upper counter rail to the outside stuff at the wing-transom, and that will give the knuckle at the outside of the quarter at the lower counter rail and rail also, as shewn in the plan of the stern.

Having represented the lower and upper counter rails, in the perpendicular plan of the stern, let them likewise be represented in the sheer-plan as follows: drop a perpendicular from the knuckle of the upper counter of the midship stern-timber in the sheer-plan to intersect the horizontal line at the knuckle of the side stern-timber; raise likewise perpendiculars from the upper counter knuckles of the side stern-timbers, in the perpendicular plan of the stern, to a line drawn at pleasure above the taffarel; then take the distance, in the sheer-plan, from the knuckle at the side stern-timber to the intersection of the perpendicular at the horizontal line, and set it off on its respective perpendiculars last squared up to the line above the taffarel, then sweep a curve that shall intersect the spots at the side and horizontal line at the middle, and it will shew what the stern rounds forward on an horizontal view. Take the heights from the line C D in the perpendicular plan of the stern to the knuckles of each counter, at the outside of the gallery on a perpendicular, and set them off from the line C D in the sheer-plan, striking there an horizontal line under their respective knuckles; then, from the perpendicular plan of the stern, raise perpendiculars from the knuckles of the timbers at the outside of the gallery to the horizontal round-forward curve above the taffarel, and take the distance from the horizontal line to the horizontal round-forward curve on those perpendiculars, and set it forward from the perpendicular at their respective knuckles on the horizontal line; which gives the exact knuckles at the outside of the gallery timbers in the sheer-plan. Then strike a straight line, to intersect the upper and lower counter knuckles of the midship and side timbers, to the spots set off for the knuckle outside of the gallery, in the sheer-plan; and, from the upper to the lower counter knuckle at the outside of the gallery make a curve to the hollow designed for the upper counter; and, a parallel curve outside of that, to the thickness of the birthing. Now take the heights of the ends of each counter rail upon a perpendicular from the line CD in the perpendicular plan of the stern, and set them off in the sheer-plan at the knuckles, outside of the galleries, and continue them forward by straight lines agreeably to the sheer of the ship; which will be the exact heights at which the lower and upper counter rails should appear on the ship.

In the manner above described may the lower counter rail be formed, by setting off the distance between that and the lower gallery rim, and there drawing in the rail which comes on the lower stool, keeping it parallel with the rim rail. The lower finishing may then be formed beneath the lower stool rail, with another stool, and a serpentine line as light and agreeable as possible.

In the next place, set aft, from the side timber, the projection of the balcony, (as given in the dimensions,) on the end of the quarter deck, and draw a line, in pencil, parallel to the stern-timber; then the foot-space rail of the balcony, as it appears in the sheer-plan, may be represented agreeably to the round-up of the quarter deck.

Now draw a line, parallel to the rim-rail in the sheer-plan, till it intersects the lower part of the foot-space rail; and that line will represent the lower edge of the rail that comes on the middle stool and answers to the foot-space rail; then, between this rail and the lower rim may be drawn in three lights, or sashes, having a munion between each light, about twelve inches broad, (or leaving that opening between each light or sash); and thus we shall have the lower gallery finished.

Again, by setting up the depth of the foot-space rail, its upper edge will likewise be represented; also the upper edge of the middle stool rail, in the sheer-plan.

In the next place, proceed to draw in the quarter piece; the heel of which must step on the after end of the middle stool: then set up the height of the upper part of the taffarel, from the dimensions, and there draw an horizontal line. The thwartship view of the taffarel and quarter pieces may then be represented in the sheer-plan thus:

Let the contour, or outside figure, of the stern, above the counter rails, be represented in the plan of the stern from the sheer-draught. Or, determine on the round-house transom, in the same manner as that of the quarter deck; and, above the upperside of the transom, set up at the middle line, the upperside of the taffarel: then take the height of the upperside of the plank-sheer, in the sheer-plan, at the side-timber, and set it off above the line at the side-timbers, in the plan of the stern. Determine on the breadth of the upper stool, by continuing upwards the birthing of the upper gallery; then, from the middle line to the heels of the quarter pieces form curves, agreeably to fancy, to the heights set off, and breadths of the upper stool and rails below it, and the out boundary of the stern will be represented in the perpendicular plan of the stern.

Proceed to represent the taffarel and quarter pieces in the sheer-plan thus: square up perpendicular in the perpendicular plan of the stern, to intersect the boundary line of the taffarel and quarter pieces; then transfer the height of each intersection, and strike horizontal lines across the stern-timbers in the sheer-plan. Draw a line parallel to, and eleven inches abaft, the side stern-timber from the quarter deck, to the top of the side in the sheer-plan; which is the aftside of the side stern-timber; then take the round forward and set it off abaft the last line or aftside of the side stern-timber, at the top of the side, in the sheer-plan; do the same also and set it off at the quarter deck; then strike a line in the sheer-plan, which shall be the aftside of the midship stern-timber. Now take the round forward, at the several perpendiculars, above the taffarel; and set them forward from the aftside of the midship timber last drawn in the sheer-plan, on their corresponding horizontal lines: draw a curve to those spots, and it will represent the foreside of the taffarel. Abaft the line which represents the foreside of the taffarel draw in the thickness of the taffarel, parallel to it, which will be the aftside of the taffarel at the middle line. A line from the upperside of the taffarel, continued down to the heel of the quarter piece, the thickness of the taffarel parallel to, and abaft, the aftside of the timbers, will be the aftside of the quarter piece; and, the siding of the quarter piece, set forward and parallel to the aftside, will represent the foreside of the quarter piece also in the sheer-plan.

Now set upon the line drawn for the projection of the balcony, the height of the upper part of the balcony breast-rail, from the dimensions; and draw it in the sheer-plan as in Plate I. The whole balcony will then be represented.

The upper gallery may now be represented by drawing the upper rim rail, parallel to the rail below, ranging it aft to the balcony breast-rail: then set off its length forward, from the dimensions, from the side counter timber, drawing a line parallel thereto, which will represent the fore-part of the upper gallery.

The fore-side of the quarter-piece will represent the after-part of it. Now draw in the upper stool-rail, parallel to the upper rim-rail, at such a height as that the upper stool may not come below the cove of the quarter-piece. Then may three sashes be drawn in between those two rails as before, by which the upper gallery will be formed.

The upper finishing should next be drawn; determining on the length, which may be about eighteen inches shorter than the upper gallery; drawing a line parallel with the rake of the stern for the fore end of it. Then let the upper part of the topside be the upper part of the upper rail, set down below that about three inches for the thickness of the rail, and about nine inches below that; and, parallel to it, draw another rail, about three inches and a half thick; from the fore end of which draw a serpentine line down to the fore end of the upper stool-rail; then will the upper finishing be completed.

Every thing relative to the head and stern being now sufficiently described, we may proceed to the rudder. First, set off its breadth, at the lower part, or heel, from the aftside of the stern-post, which also represents the fore part of the rudder; then, set off the height of the lower hance and the breadth at that place, from the dimensions. Next draw a line thence to the breadth set off at the lower part, by which the aftside of the rudder will be described below the lower hance; then set up the height of the upper hance, and its breadth in the same manner, and draw it in, connecting it at the lower hance by a moulding. The back may be drawn, taking its thickness from the dimensions, and drawing in a line parallel to the aftside of the rudder, from the lower hance down to the lower end, to that thickness by which the back will be represented.

The head of the rudder is to run high enough to receive a tiller above the upper deck; therefore, set off the size of the head, fore and aft, above the upper deck, and draw a line thence down to the break at the upper hance, by which the aft part of the rudder will be represented all the way up. The bearding should be represented by drawing a line from the head of the stern-post down to the lower end of the rudder, at two-fifths of its thickness from the foreside. But observe that, although two-fifths of the thickness is found to beard the foreside of the rudder no more than is necessary, yet when it is wholly taken from the rudder the upper pintle wounds it very much; therefore, let the aftside of the stern-post partake of the bearding, and, by that means, the bearding on the rudder will be so much the less; and, consequently, much less wounded by letting on the upper pintle. In describing of the bearding on the rudder, in the sheer-plan, the most proper way will be to proceed as follows.

Draw a line at pleasure, (as at the upper side of the wing-transom in the sheer-plan,) from which set off half the size of the rudder at the wing-transom on each side of it, and draw lines parallel to the fore and aft dimension of the rudder; then square up a line at the foreside, and that will represent the aftside of the stern-post likewise: set off from the last line, or foreside of the rudder, two-fifths of the thickness, or what the rudder is athwartships, at that place on each side; and at the middle line, on the foreside, the size or diameter of the pintle; and thence draw a line, on each side, to the spots set off on the side, and you will have the shape of the bearding of the rudder at that place; then take how much the rudder is athwartships at the lower end; set it off equally from the middle line and parallel thereto, and we have the shape of the bearding at the lower end; then, the distance from the foreside of the rudder to where the bearding intersects the side must be taken at its respective places, and set off accordingly abaft the stern-post in the sheer-plan. A line being now drawn to those spots, the bearding will be represented exactly as it appears in the sheer-plan; that is, supposing the stern-post not bearded. It now remains only to say that, as much as the aftside of the post may be bearded, so much the less will be the bearding of the rudder from the two-fifths.

The pintles and braces may next be drawn; first determining on the upper one, which must be disposed of in such a manner, that the straps shall come round the head of the standard which fays against the helm-port transom on the gun-deck, and meet at the middle line, by which there is a double security both to the brace and to the standard. It must therefore be placed above the wing-transom to come in that situation. The second brace must be placed just below the gun-deck, so as to fasten in the middle of the deck transom, and the rest may be spaced equally between that and the lower one. The lower one may be placed about one foot above the upper edge of the keel. The number of braces in the table of dimensions for the eighty-gun ship will be found to be seven, but it may be regulated by the distance between the second and upper one, letting the distance between the rest be nearly the same.

The length of the braces will be found by setting off the length of the lower one, (which by the table is eight feet afore the back of the stern-post,) and likewise the length of the third (which is four feet six inches afore the back of the stern-post); then, by drawing a line from one to the other, the lengths of the intermediate ones will be found, as they appear on the sheer-plan.

The length of all the straps of the pintles, which come upon the rudder, may be within four inches of the aftside of the rudder; and, the rudder being a flat surface, they will all appear of their true lengths.

The sheer-plan being thus far drawn, and every part thereof represented, as far as can be done without the assistance of the body-plan, we shall, in the next section, proceed to draw in the body and half-breadth plans; and, also, describe those parts of the sheer-plan which are not yet represented, on account of their connexion with the body and half-breadth plans.

OF CONSTRUCTING THE BODY AND HALF-BREADTH PLANS, WITH FURTHER OBSERVATIONS ON THE SHEER-DRAUGHT.

The half-breadth plan must first be drawn; in order to which, draw a straight line below the sheer-plan, the whole length of the ship, and parallel to the upper edge of the rabbet of the keel, observing to keep it of a sufficient distance beneath the keel line, to admit of the main half-breadth line coming clear of the keel and scale; then, from the upper edge of the keel square down all the joints of the frames to the line just drawn, which line is the middle line in the half-breadth plan, and represents the middle line of the ship, passing fore and aft, or lengthwise. The foremost and after perpendiculars should also be squared down to the middle line in the half-breadth plan.

Now, where the height of breadth lines, in the sheer-plan, intersect the aft part of the rabbet of the stem, square it down to the middle line in the half-breadth plan; and, likewise, the fore part of the stem: then take, from the table of dimensions, what the stem is sided at that place, and set off half of it from the middle line in the half-breadth plan, on the lines so squared down; then, drawing a line to intersect the lines so squared, the half-breadth of the stem will be represented in the half-breadth plan: now, with compasses, take the thickness of the plank of the bottom, which is four inches, and describe the rabbet of the stem in the half-breadth plan.

In the next place, square down to the middle line in the half-breadth plan, where the height of breadth lines, in the sheer-plan, intersect the counter-timber at the side; also square down where they intersect the counter-timber at the middle line; then, when the main half-breadth line is run, the half-breadth of the counter will be given on the line first squared down. From the spot to where the line last squared down intersects the middle line, sweep a curve, the centre of which will be in the middle line, by which the half-breadth of the counter will be represented at the height of breadth, the broadest part of the stern.

Then take the main half-breadth of timber dead-flat from the table of dimensions, and set it off from the middle line on dead-flat in the half-breadth plan; take also from the dimensions of bodies the main half-breadth of every timber there expressed, setting them off respectively from the middle line on their corresponding timbers in the half-breadth plan; then, by letting a curve line pass from the end of the line representing the half-breadth of the counter, through all the spots set off on the timbers, to the aft part of the rabbet of the stem, the main half-breadth line will be represented, by which is shewn a section of the ship lengthwise at the broadest place, supposed to be at the height, and in the direction, of the height of breadth lines in the sheer-plan.

Now take, from the dimensions of bodies, the top-timber half-breadth, by which the top-timber half-breadth line may be described, proceeding in the manner above described for the main half-breadth line.

Take also from the dimensions of bodies the half-breadth of the rising, and set it off from the middle line on the corresponding timbers in the half-breadth plan, observing where the word *outside* is expressed in the tables, the half-breadth for that timber must be set off below (or outside) the middle line; then, by drawing a curve to intersect all the spots set off, the half-breadth of the rising will be represented in the half-breadth plan.

We may now quit the half-breadth plan for the present, and proceed to the body-plan. Draw a line at the after end of the sheer-plan, at the same height as the upper edge of the rabbet of the keel; then erect a perpendicular on that end nearest the sheer-plan, observing to keep it clear of the stern; from that line set off the main half-breadth of dead-flat, and erect another perpendicular; at the main half-breadth from that, erect a third perpendicular: the line first drawn is the base line, the first perpendicular is called the side line of the fore-body, the second perpendicular the middle line, and the third perpendicular the side line of the after-body; by which three lines, and the base line first drawn, we shall be able to construct the body-plan, as the heights and breadths must be all set off from those lines.

In the next place take, from the table of bodies, the heights of the diagonals up the middle line, and set them off from the base line up the middle line; take also, from the table, the distances of them from the middle line on the base line, and set them off; likewise their heights up the side line, and set them off also; then draw in the diagonal lines, from the spots set up the middle line to their corresponding spots on the base and side line.

The diagonals being drawn, we may next proceed to the height of breadth lines; therefore take, from the sheer-plan, the heights of the lower height of breadth line in the after-body, and set them off up the middle line in the body-plan, and likewise up the side line of the after-body; then, at every one of the heights set off, draw an horizontal line in pencil from the side to the middle line.

Now take off the upper height of breadth line, and proceed in the same manner as described for the lower height of breadth line.

The rising must next be set off on the body-plan; in order to which, we must first describe it in the sheer-plan, by taking the heights from the table of bodies, and setting them off above the upper edge of the rabbet on their corresponding timbers in the sheer plan; then, by drawing a curve to pass through the heights set off, the rising line will be described in the sheer-plan: next take, from the table, the rising height of dead-flat, and set it off in the body-plan, drawing an horizontal line; again, take all the rising heights from the sheer-plan; set them off in the body-plan, above the line drawn for the rising height of dead-flat *, and draw horizontal lines at the said heights: take from the half-breadth plan the half-breadths of the rising, and set them off from the middle line in the body-plan on their corresponding heights, which will give the centres of the floor sweeps for their corresponding timbers.

Now take, from the half-breadth plan, the main half-breadth line; and set it off from the middle line in the body-plan, on the corresponding lines already drawn for the lower height of breadth; then, from where they intersect the lines of their respective heights, set off the lengths of their respective lower-breadth sweeps.

Again take, from the table of bodies, the distance of each timber from the middle line on the diagonals, and set them off from the middle line on their respective diagonal lines, making spots at the different distances; then, having those spots set off, the lower-breadth sweeps described, and likewise the floor sweeps, the shape of the timbers below the breadth may now be described, as follow:

First, describe the midship-timber or dead-flat, placing one leg of the compasses in the distance set off for the length of the lower-breadth sweep, and extend the other to the spot which terminates the breadth in the side line; thence describe a circle downwards, which will intersect the spots set off on the upper diagonal lines, letting it pass as low as convenient; now fix one leg of the compasses in the centre of the floor-sweep, and the other in the spot set off on the diagonal next to the floor-head, and describe a circle, letting it intersect as many of the spots on the diagonals as it will; then, draw a curve passing from the back of the lower-breadth sweep, through the spots on the diagonals, down to the back of the floor-sweep; and, from the back of the floor-sweep, let another pass through the spots on the lower diagonals to intersect the upper part of the rabbet of the keel; the midship timber will then be formed below the breadth; and, by proceeding in the same manner with the rest of the timbers, they may all be formed below the lower height of breadth.

Now proceed to form the timbers above the lower height of breadth, where the timbers already drawn intersect the lower height of breadth lines; square them up to their corresponding upper height of breadth lines, and thence set off the length of the upper-breadth sweeps; then fix one leg of the compasses in the spots set off for the upper-breadth sweeps, and the other leg in the line squared up; whence describe a circle upwards: then, from the sheer-plan, take off the heights of the top-timber line, and set them off in the body-plan, drawing horizontal lines, on which set off the top-timber half-breadths, taken from their corresponding timbers in the half-breadth plan.

* In the sheer-draught of the seventy-four gun ship this height is represented by the upper edge of the rabbet of the keel, otherwise it would interfere with the upper works. In other ships, it may, of course, be varied according to the figure of the body.

Next, by drawing curves passing from the back of the upper-breadth sweeps so as to intersect the top-timber half-breadths, the timbers will be formed from the keel to the top of the side. The upper end of the timbers will be determined by taking the heights of the upper part of the topside above the top-timber line, and setting them off above the top-timber line on their corresponding timbers in the body-plan. The lower part of the timbers are ended at the rabbet of the keel, which must be described in the following manner:

Having the keel drawn in the body-plan, by setting off, from each side of the middle line, half its siding, and its depth below the upper edge of the rabbet, set the compasses to the thickness of the bottom, which is four inches; fix one leg where the line for the thickness of the keel intersects the base line; and, with the other, describe the arch of a circle to intersect the keel line and the base; then, fix one leg where the arch already described intersects the side of the keel, and, with the other, describe an arch from where the keel intersects the base, till it intersects the other arch; then, from the intersection of both arcs, draw a straight line to the intersection of the keel and base line, and another line to the intersection of the lower arch with the side of the keel, by which the rabbet of the keel will then be described in midships; therefore, all the timbers in the midship part of the ship, which have no rising, terminate where the upper edge of the rabbet intersects the base line; but, when the timbers begin to rise, the lower part of them will end in the centre of the rabbet, that is, where the two arcs intersect each other.

Those timbers which come near the after end of the keel, must be ended by setting off the half-breadth of the heel at the post, in the half-breadth plan, and describing the tapering of the keel; then, at the corresponding timbers, take off the half-breadth of the keel, and set it off in the body plan; then proceed as before to describe the rabbet, letting every timber end, where the two arcs for its respective rabbet intersect.

The timbers being now formed and ended, proceed to draw in the side-counter, or stern timber; take the height of the wing transom, lower counter, upper counter, and top-timber line, at the side, from the sheer plan, and transfer them to the body plan, drawing horizontal lines at those heights; draw in likewise two horizontal lines spaced equally between the wing transom and lower counter, and one spaced equally between the upper counter and the top-timber line in the sheer-plan, and transfer them to the body plan.

Then, where the aftside of the stern timber at the side intersects the wing transom at the side, in the sheer plan, square it down to the middle line in the half-breadth plan; square down also the knuckle or touch of the upper and lower counter, and likewise where the stern timber intersects the two horizontal lines drawn between; and, where the stern timber intersects the horizontal line between the upper counter and top-timber line; then, having those lines squared down to the half-breadth plan, you must proceed to form curves in the half-breadth plan for the shape of the body at every one of those heights.

In order to effect which, begin with the horizontal line representing the height of the wing-transom in the body-plan, lay a strip of paper to that line, and mark on it the middle line, and likewise the timbers 36, 34, 32, and 30, transfer it to the half-breadth plan, fitting the spot marked off on the paper, for the middle line, well with the middle line of the half-breadth plan; and, setting off the half-breadths on their corresponding timbers, 36, 34, 32, and 30; then draw a fair curve to pass through the spots set off, and to intersect the line squared down from the sheer-plan. Then proceed, in the same manner, with the horizontal lines at the height of the counters, between the lower counter and wing transom, above the upper counter and top-timber line; and, from where the curve so drawn in the half-breadth plan intersects the lines that were squared down from the sheer plan, take the distance to the middle line, and set it off on their corresponding lines in the body plan; now, by drawing a curve to pass through the several spots so set off, the stern timber will be described in the body plan*.

The round-up of the wing transom upper and lower counter, may now be taken off from the sheer draught, and set off at the middle line above their respective horizontal lines in the body plan, by which their arcs or round-up may be drawn in. The round-aft of the wing transom may also be taken from the sheer plan, and set off at the middle, abaft the line squared down for the wing transom in the half-breadth plan, by which the arc or round-aft of the wing transom will be described.

The after body being now completely formed, proceed to the formation of the fore-body in the same manner. The particulars which differ from the former may be described as follow:

The heeling of the foremost timbers must be considered, as the ending of them is on the stem, and consequently differs from those in the after body; draw a line in the body plan distant from the middle line half of what the stem is sided. Then, take the height in the sheer plan where the timber (which is required to be ended) intersects the lower part of the rabbet of the stem, and set it off on the line before drawn in the body plan, there making a spot; then, with compasses, take the distance in the sheer plan from where the timber intersects the lower part of the rabbet of the stem, to the intersection of it with the upper part, and fix one leg of the compasses in the spot already made in the body plan, and, with the other, describe a circle, keeping the compasses at the said distance; and the timbers may then pass over the back of the circle so described; then, by applying a small square to the timber, and letting the back of it intersect the spot set off for the lower part of the rabbet, the lower part of the rabbet will be described, and likewise the ending of the timbers.

The foremost timbers should also be considered at the head, as they also differ very much in that part from those of the after body; because, in consequence of the ship's carrying her breadth so far forward at the top-timber line, (being nearly as broad forward as in midships,) it occasions the foremost frames to fall out at the head beyond the main breadth, from which they are called *knuckle timbers*. To describe them, proceed as follows:

The height of the top-timber line being set off in the body plan, set off upon it the top half-breadth taken from the half-breadth plan; and, at that place, draw a perpendicular line; then, from the sheer plan, take the

* These lines are to be drawn only in pencil, and rubbed out when the side counter timber is formed. Consequently they do not appear on our Sheer-draught; because, if kept in, they would have confused the draught.

height of the top of the side, and set it off on the perpendicular line in the body plan; likewise take the breadth of the rail at the top-timber line, in the sheer plan, and set it off below the top-timber line, at the perpendicular line in the body plan, by which will be determined the straight part of the knuckle timber to be drawn; then, from the last mentioned spot, let a curve pass through the spots set off for the timber, down to the upper breadth, and the whole knuckle timber will then be formed, by which it will be seen that those timbers forward will fall out *beyond* the main breadth with a hollow, contrary to the rest of the top-side, which falls *within* the main breadth with a hollow.

The after and fore body being now completely formed, we may proceed to draw the water lines on the body plan, from which they must be described on the half-breadth plan, in order to prove the fairness of the bodies.

In this draught the water lines are all represented parallel to the keel; their heights, therefore, may be taken from the sheer plan, and transferred to the body plan, drawing horizontal lines, by which the water lines on the body plan will be represented as marked wat. 1, wat. 2, &c. but, in ships that draw more water abaft than afore, the water lines will, consequently, not be parallel to the keel; the heights must then be taken at every timber in the sheer plan, and set off on their corresponding timbers in the body plan; and, drawing curves to pass through the different spots, the water lines will be thereby represented in the body plan.

Now, take the distances from the middle line to where the water lines intersect the different timbers in the body plan, and set them off from the middle line on their corresponding timbers in the half-breadth plan, where the water lines in the sheer plan intersect the fore part of the rabbet of the stern-post, square them down to the half-breadth plan, and upon the lines so squared down, set off the half thickness of the stern post at its corresponding water line, (which may be taken from the body plan, by setting off half the size of the post at the head and the heel from the middle line; and, drawing a line for the tapering of it, where the line so drawn intersects the water lines, will be the half thickness required;) then set the compasses to the thickness of the plank, and fix one leg where the half thickness of the post intersects the line squared down; and, with the other, describe an arc, from the back of which the water lines may pass through their respective spots, and end at the fore part of the half-breadth plan, proceeding in the same manner as with the after part.

The aft part of the rabbet of the post may be squared down from the water line to the spot set off for the half thickness of the post, by which the rabbet will be represented; and, in the same manner may the water lines be ended at the rabbet of the stem. The water lines being all described, we shall now be able to see if the body is fair, and whether the timbers require any alteration; if they should, it must be complied with.

The cant timbers of the after body may next be described in the half-breadth plan, in order to which we must first determine on the cant of the fashion-piece; therefore, having the round-aft of the wing transom represented in the half-breadth plan, and likewise the shape of a horizontal line at the height of the wing transom, set off the breadth of the wing transom at the end, which is one foot four inches, and there make a spot on the horizontal line, which is the place where the head of the fashion-piece will come; then, to determine on the cant of it, we must consult the shape of the body, because it must be canted in such a manner as to preserve as great a straightness as is possible for the shape of the timber, by which the latter will be much stronger than if very crooked, for, if very crooked, it would be much cut against the grain; we must also consider the cant, so as to give the timber as little bevelling as possible, by which considerations, the conversion will be very much assisted.

Therefore, let the heel of the timber be set off on the middle line about four feet afore timber 36; and, drawing a straight line thence to the spot set off on the horizontal line for the wing transom, the cant of the fashion-piece will be described, and will be found situated in the best manner possible to answer the before-mentioned purposes.

The cant of the fashion-piece being represented, we may now easily determine on the cant of the other timbers; let timber 29 be the foremost cant timber in the after body, and draw in timber 28 in pencil; then observe how many timbers there are to come in between 28 and the fashion-piece, which you will find to be eight in number, viz. 29, 30, 31, 32, 33, 34, 35, and 36; then, with compasses, divide the distance between timber 28 and the fashion-piece on the middle line, into seven divisions; proceed then to do the same on the main half-breadth line; and, by drawing straight lines from the divisions on the half-breadth line to their corresponding divisions at the middle line, the cant timbers of the after body will be represented.

The line drawn for the cant of the fashion-piece represents the aftside of it, which comes to the end of the transoms; but, in order to help the conversion with regard to the lower transoms, there may be two more fashion-pieces abaft the former; therefore, the foremost fashion-piece, or that which is already described in the half-breadth plan, only take the ends of the three upper transoms, which are the wing, filling, and deck transoms; the middle fashion-piece takes the four next, and the after fashion-piece the lower ones; therefore, set off in the half-breadth plan, the siding of the middle and after fashion-piece, which may be thirteen inches each; then, by drawing of lines, parallel to the foremost fashion-piece, at the aforesaid distance from each other, the middle and after fashion-piece will be represented in the half-breadth plan.

The fashion-pieces and transoms yet remain to be represented in the sheer plan; in order to which, determine on the number of transoms required; these, may be five in number below the deck transom. Draw them in pencil, beginning with the wing, the upper side of which is represented by a horizontal line at its height; set off its siding below that, and draw a horizontal line for the lower edge.

The filling transom follows, which is merely for the purpose of filling the vacancy between the under edge of the wing transom and upper part of the deck plank; therefore it may be represented by drawing of two horizontal lines for the upper and lower edges, leaving about two inches between the upper edge and lower edge of the wing transom, and four inches between the lower edge and the gun-deck plank. The deck transom must be regulated by the gun deck, letting the under side of the gun deck plank represent the upper side of it, and setting off its siding below that, the under edge may be drawn in also; the transoms below the deck may all be sided equally, which may be eleven inches; they must also have a sufficient distance between them for the circulation of air to preserve them, as those timbers are more difficult to shift than any others in the ship; therefore, set them off so to have about three inches distance between each; and, by drawing horizontal lines at their different heights, they will be represented.

The transoms being now drawn in pencil, we must proceed to find the length of them as they appear in the sheer plan, in order to draw them in ink; we must, therefore, describe the thwartship appearance of the fashion-pieces as they appear in the sheer plan, by which the length of the transom will be determined.

The foremost fashion-piece may be first described, as that reaches above the upper transoms; in order to which, draw in the sheer plan a sufficient number of horizontal lines; or, as the water lines are horizontal, they will suffice, only by drawing one horizontal line between the upper water line and the wing transom, and one above the wing transom at the height you intend the head of the fashion-piece should run, which may be from three to five feet; then take the heights of those two horizontal lines and transfer them to the body plan; and then run them in the half-breadth plan, in the same manner as the water lines; then, where the line drawn for the cant of the fashion-piece in the half-breadth plan intersects the horizontal line for the head of the fashion-piece, square it up to the said horizontal line in the sheer plan, making a spot; square up, also, the intersection of the cant line with the horizontal line for the wing transom in the half-breadth plan, to the corresponding line at the wing transom in the sheer plan; then, square up where the cant line in the half-breadth plan intersects the horizontal line below the wing transom; and, also, the water lines, to their corresponding lines in the sheer plan. Now, by drawing a curve to pass through the several spots to set off, the thwartship view of the foremost fashion-piece will be described, as it appears when seen in the sheer plan; in the same manner may the middle and after fashion-pieces be described, observing to let the middle one run up no higher than the under part of the deck transom, and the after to the under side of the fourth transom under the deck; the transoms may now be drawn in ink as their lengths are limited by the lines for the fashion-pieces.

The stern post may now be completed, as the fore side of it has not yet been drawn in, nor the head of it determined. Take, from the dimensions, how much the stern post is fore and aft at the keel, and set it off on the upper edge of the keel, from the line representing the aft side, making a spot; then the head of the post must be determined, which must run high enough to admit of the helm port transom and the tiller coming between it and the upper deck beams; reserving about three inches from the underside of the tiller to the helm port transom, and two inches between the upper side of the tiller and under side of the deck beams. The head of the stern post, therefore, will be two feet nine inches above the wing transom. Draw a horizontal line for the head at that height, and set on it the size of the stern-post at the place taken from the dimensions; then, drawing a straight line thence down to the spot set off on the keel, (observing not to draw the line through the transoms, as it will only appear between them) the fore side of the stern post will be described, and the stern post completed.

The inner post may be drawn by setting off its dimension fore and aft from the stern post, and drawing a straight line as before, continuing it no higher than the under side of the deck transom.

The cant timbers of the after body being described, and every part also which depended on them, we may now proceed to the cant timbers of the fore body; in order to which, we must first determine on the foremost and aftermost cant timber, and likewise on the cant of the foremost one; therefore, under the considerations explained with respect to the after body, the foremost cant timber will extend as far forward as to be named Z. The cant on the middle line may be five feet three inches abaft square timber X; and, on the main half-breadth line three feet nine inches before X, in which situation the line may be drawn for the cant; the aftermost may be timber *p*. All may now be drawn in, proceeding as before described for those of the after body, which is spacing them all equally between the cant timber *z*, and the square timber O, both on the main half-breadth and middle line; and, drawing lines from the spots on the main half-breadth line to their corresponding spots on the middle line; observing to let them run out to the top-timber half-breadth line, where it comes withoutside the main half-breadth line.

The hawse pieces must next be considered in the half-breadth plan, the sides of which may be parallel with the middle line, or canted. Take the siding of the apron, from the dimensions, which may be about four inches more than the stem, (unless the rabbet be in the middle of the stem, then the siding of the apron can be no more than the stem;) set off one-half of it parallel from the middle line, drawing a line from the main half-breadth to the foremost cant timber, which will represent the foremost edge of the knight head; from that set off the siding of the knight head, from the dimensions, and draw in the aftside of it: the hawse pieces, which are four in number, may then be drawn, by setting off their sidings, from the dimensions, parallel to the knight head, or as in Plate I; then, by drawing straight lines from the main half-breadth line to the foremost cant timber, they will be represented.

In the next place, describe the hawse holes, which should be placed in such a manner as to wound the hawse pieces as little as possible; they may therefore be placed so that the joint of the hawse pieces shall be in the centre of the holes, by which they will only cut half the hawse pieces; whereas, were they placed between the joints, they would cut off the hawse pieces. Take from the dimensions the size of the hawse holes, and set off the foremost one, or that next to the middle line on the joint between the first and second hawse piece, then set off the other on the joint between the third and fourth hawse piece, and, by drawing lines across the main half-breadth line at their respective places, they will be represented in the half-breadth plan. Or, to avoid wounding the hawse pieces, have middle pieces sided six inches less than the holes; then, by cutting three inches on the sides of the hawse piece between the holes, those hawse pieces, being sided more, are wounded proportionably, but little.

The hawse holes should now be represented in the sheer plan; in order to which, determine on their place there; in the seventy-four gun ship they are placed between the cheeks; therefore set off their diameter between the cheeks, leaving sufficient substance for the bolster; and, drawing lines parallel to the cheeks for their upper and lower part; then, to determine on their situation agreeably to the half-breadth plan, set off the thickness of the inside and outside plank, the fore and aft way; we must then square up, from the half-breadth plan, where they intersect the inside and outside plank at the main half-breadth line, to the lines drawn between the cheeks, in the sheer plan; which will give the true situation the fore and aft way; then, by drawing them circular, agreeably to the spots set off, they will be represented as they appear ticked in the sheer plan.

The apron may be drawn in the sheer plan, setting off its size fore and aft from the stem, letting it come down so as to scarph about two feet higher than the foremost end of the fore foot, by which it will give shift to the scarphs of the stem, and so continued up to the head of the stem.

The cutting down should next be drawn; therefore take, from the table of bodies, the different heights there expressed, and set them off from the upper edge of the rabbet of the keel on their corresponding timbers in the sheer plan; then, by drawing a curve to pass through the spots set off from the inner post aft to the apron forward, the cutting down line will be represented.

To describe the limber-strake, draw a line parallel to its thickness, as in the dimensions, above the line representing the cutting down, which is eight inches. Thus will the limber-strake be described, from which the depth in the hold is always measured.*

It here becomes requisite to observe that the limber-strake, keelson, dead-wood knee, and stemson, are not represented in the sheer draught, as they would interfere too much with the other lines in that plan. But they may be very clearly represented as in the Sheer Draught, Plate I.

Proceed now to draw in the keelson, by taking the depth of it from the dimensions, which is one foot five inches, and setting it off above the cutting down line; then, by drawing a line parallel to the cutting down, the keelson will be described.

The cutting down line being described, we are now enabled to represent the knee of the dead wood abaft timber 28, being the after floor timber: set off the siding of the floor abaft it, and erect a perpendicular line in the sheer plan, which will terminate the foremost end of the after dead wood; then, the fore and aft arm of the knee may be half the length of the whole dead wood, and the up and down arm reach to the under part of the lower transom. The whole knee must be placed in such a manner that the upper piece of dead wood shall bolt over it, and be of as much substance as the knee itself; therefore, the cutting down line representing the upper part of the dead-wood, the knee must consequently be placed its whole thickness below that line.

Next draw in the sternson knee, which fays upon the upper piece of dead-wood and scarphs with hook and butt, about twelve feet long, into the after piece of the keelson. The up and down arm extends up to the upper side of the deck transom also.

The stemson fays against the apron and runs up so as to tenon into the under side of the upper deck hook and the heel, and scarphs into the fore end of the keelson with hook and butt three feet long. The dimensions may be found in the table.

The PLAN OF THE HEAD may be drawn in by continuing forward the middle line of the half-breadth plan. Upon it, square down the foreside and aftside of the figure from the sheer plan; and, upon those lines, set off half the siding of the figure from the middle line, as in the table of dimensions.

Then draw the main rail to its half-breadth appearance thus: set off the siding of the after end of the main rail from the outside of the plank at the top-timber half-breadth, at the foreside of the beak-head; and, also, the siding of the fore-end from the outside of the figure; the fore-end being squared down from the fore part of the hair-bracket in the sheer plan; observing, however, to add to the siding the thickness of the lining: then, by drawing straight lines to those spots, the half-breadth plan of the main rail will be described.

Square down, from the sheer plan, the head timbers where they intersect the under side of the main rail to the middle line of the half-breadth plan: likewise, square down the fore and aft sides of the knight-head, and run the half-breadth line at the upper side of the beak-head and thickness of the outside plank.

Square up, from the middle line of the half-breadth plan, the head beam, so as to let aft about two inches upon the stem; and, square up, likewise, the cross-piece at the foremost head timber, to which the main rail is secured by knees on the aftside.

Parallel to the middle line, draw in half the diameter of the bowsprit; then draw the fore and aft carling, rather without the bowsprit, so that the gammoning may lead down clearly.

The flat of the head, which is composed of ledges, may next be drawn, and the boomkins represented thus: Square down, from the sheer plan, the centre of the foremast, at the upper deck, to the middle line in the half-breadth plan; whence draw out a line forming an angle of 36 degrees with the said middle line; and, upon it, set off half the length of the fore yard forward; then square it down to the middle line of the half-breadth plan; draw in the boomkins parallel to the line which forms the angle abovementioned, and they will come nearly over the middle head-timber, the heels resting against the knight-head; the length may be regulated by the line squared down from the fore yard arm.

The seats of ease may now be drawn. Those for the officers are in the round-houses; those for the seamen are two on each side afore and abaft the boomkins, and one on each side next the round-houses. Sometimes, instead of the latter, cisterns are fitted, to wash in occasionally. The rest of the head is then framed with ledges as before observed.

The sheer draught is now completely formed, and every part thereof represented, as also the body and half-breadth plans, from which the ship may be laid down in the mould loft, and likewise the whole frame erected. To complete the draughting, there now remains to draw a profile of the inboard works, Plans of the Decks, &c.; but, as the use of the diagonal lines in the body plan has not yet been sufficiently explained, we shall first proceed to treat of them.

AN EXPLANATION OF THE NATURE AND USE OF THE DIAGONAL LINES IN THE BODY PLAN.

The diagonal lines in the body plan are given in the tables of bodies, merely for the purpose of forming the body therefrom; but, after the body is formed, they are of very principal use; as, at their stations, the ribbands and harpins which keep the body of the ship together whilst in her frames, are all described, and the heads of the different timbers in the frame likewise determined; consequently it follows that a particular explanation of them is necessary, as they are the diagonal lines or ribbands that are used in the laying-off of the ship: we shall therefore begin with

The Lowermost, or number 1, which is termed the *Lower Diagonal*, at which place the lowest bevellings of the timbers are taken; its situation is generally in the middle between the keel and floor ribband.

The Second Diagonal is placed in the midships, about eighteen inches in small, and two feet in large ships, below the floor head; it is the station where the floor ribband is placed in midships, and likewise the floor harpin forward; there is also a bevelling taken at this diagonal, all the way fore and aft, from which it is termed the *Floor Ribband*.

The Third Diagonal terminates the length of the floors, and is therefore called the diagonal at the Floor Head; there are likewise bevellings taken at this diagonal to as far forward and aft as the floor extends. The placing of this diagonal is of the utmost consequence to the strength of the ship, it being so near to that part of the bilge which takes the ground, that it, consequently, is always liable to the greatest strain. It should therefore be placed as much above the bearing of the body in midships as can be conveniently allowed by conversion of the timber; but, afore and abaft, it is not of so much consequence.

The Fourth Diagonal is placed in the middle between the floor head and fifth diagonal, at which place, a ribband and harpin are stationed for the security of the first or lower futtocks, from which it is termed the First Futtock Ribband. There are also bevellings taken at this diagonal all fore and aft, which being part of the body where the timbers most vary, occasion them to be the greatest bevellings in the whole body.

The Fifth Diagonal terminates the heads of the first futtocks, and is therefore called the First Futtock Head; it should be placed at a convenient distance above the floor head, in order to give sufficient scarph to the lower part of the second futtocks, which is particularly observed in the tables of dimensions. Bevellings for the timbers are likewise taken at this diagonal all fore and aft.

The Sixth Diagonal, called the Second Futtock Ribband, should be placed in the middle between the first futtock head and seventh diagonal, at which place the ribband and harpin are stationed for the support of the second futtocks. Bevellings are also taken at this diagonal all fore and aft.

The Seventh Diagonal called the Second Futtock Head, terminates the second futtock heads from the fore to the aftermost floors, and afore and abaft them it terminates the double futtock head in the fore and after cant bodies; it should be placed in midships as much above the first futtock head, as the first futtock is above the floor-head, by which it gives the same scarph to the lower part of the third futtock as the first futtock does to the second: there are bevellings also taken all fore and aft at this diagonal.

The Eighth Diagonal is the station for the ribband and harpin which supports the third futtocks, and is therefore placed between the second futtock head and ninth diagonal; it is also a bevelling place, and is termed the Third Futtock Ribband.

The Ninth and last Diagonal, called the Third Futtock Head, is placed at the same distance above the second futtock head, as that is above the first, and it terminates all the heads of the third futtocks excepting such as come under lower deck ports. The latter must run up to the under part of the ports, as no short timbers should, by any means, be admitted under the ports, which require the greatest strength that is possible. This diagonal is a bevelling place for the heads of the third futtocks.

The fourth futtock heads are terminated by the under part of the upper deck ports all fore and aft, and a ribband is placed fore and aft a little below the height of the lower sills of the upper deck ports. Another is placed in like manner, at the lower deck ports, and one at the top-timber line, which, with the ribbands and harpins beforementioned, keeps the whole body of the ship together, and in its proper form and shape.

It must be observed, that the diagonal lines laid down in the table of bodies, will not correspond to what has been said upon the diagonals in this chapter, as they were drawn discretionally upon the body for the purpose of giving the true dimensions of it; the student must therefore, when he has his body drawn in fair, rub out the first diagonals (which should only be in pencil) and then proceed to draw in the proper diagonals in red ink, strictly adhering to what has been said on the subject.

ADDITIONAL OBSERVATIONS ON THE RISING LINE IN GENERAL.

The method of constructing the midship floors of some ships, by lengthening the radii afore and abaft, is preferable to the rising line as used in constructing merchant ships of burthen, where the radii of the floor sweeps all fore and aft are of the same length as at the midship bend; because, by this method, every floor from dead-flat is graduated by a larger circle. But this method is not so generally serviceable in laying-off the ship; because, in any ship constructed by the same length of radius, you may venture, so far as the rising line is continued, to lay down the body on the mould-loft floor, without running any ribband or horizontal lines till that part is finished. Again, this method affords a greater assistance; as, by it, the floors may be nearly constructed all fore and aft, but the floors near the midships only can be constructed when the radii of the floor sweeps alter much in their length.

Neither the rising line nor the half-breadth of the rising would continue the curves as first constructed, if the form of the body were designed to be altered in that part. It is evident, then, that the rising line may be drawn according to the judgment of the artist in the construction of any draught, observing to make it a fair elliptical curve: for much depends in the construction of the lower part of the body, by judiciously narrowing the floor-sweep or half-breadth of the rising; for, the more parallel it is kept with the middle line, the less will be the velocity of the vessel: and, again, the quicker this curve is, the less bearing will the vessel have; and, though it may be supposed, when the rising line is formed, and the half-breadth of the rising, it is reasonable to expect a fair draught, yet we cannot be certain of its producing that form of body which we really intend, agreeably to the use which the ship is designed for; unless, by frequently constructing of bodies, we can form an exact idea before we proceed. Therefore we would recommend the young artist to improve himself by drawing those bodies from the dimensions which are constructed by the rising-line, and of different properties, till he forms in his own judgment a perfect idea of this mode of construction. Then, when the draught is finished, the water lines run, and the buttock lines or vertical sections are run all fore and aft on the sheer-plan, some room for alterations may be perceived; then, you may observe whether the rising line, and half-breadth of the rising line (or, as it is sometimes called, the narrowing of the floor-sweeps,) correspond with that part which you intend to alter. If it be required to make the ship cleaner, lift the rising line, and narrow the half-breadth of the rising line; and, where it may be required to make the ship fuller, lower the rising line; which sufficiently proves, that the rising line is as variable as the different forms of the bodies; but is yet a very complete method of constructing the lower part of such ships fair, as require some provision, or fullness of body, to assist them when taking the ground. The farther forward and aft the body is assisted by the rising line, the more merit there will be in the construction, and the greater certainty of producing a fair body.

INSTRUCTIONS FOR DELINEATING THE DISPOSITION OF ALL THE TIMBERS COMPOSING THE FRAME; LIKEWISE FOR EXPANDING THE BOTTOM AND TOPSIDE, BY WHICH THE LENGTH, BREADTH, AND NUMBER, OF ALL THE PLANKS MAY BE KNOWN, &C.

1. OBSERVATIONS ON, AND INSTRUCTIONS FOR, THE DISPOSITION.

To give the true shift and appearance of every timber in the ship, may perhaps be thought, by some of our readers, to be superfluous; but, as our grand object is, to acquaint the young beginner with every thing interesting in the science, and with the means of calculating every particular required in the erection of a ship, we now proceed to explain the nature and use of a disposition of the frame, and of the planking expanded as represented in Plate III. of this work.

The utility of plans of this description requires but little explanation; as it is evident, upon inspection, that they exhibit the disposition and shift of every timber and every plank used in a ship, and, consequently, afford the means, before the ship comes on the stocks, of disposing of every piece to the greatest advantage, both with respect to the strength of the ship and to the conversion of the timber; and, moreover, of preparing every piece for its proper situation with the greatest facility.

Without enlarging, unnecessarily, upon these important advantages, we shall now give some instructions for the disposition of the timbers, &c.

With respect to the frame timbers, it is, in the first instance, of the greatest consequence to the strength of a ship, that they should be cut as little as possible by the ports on each deck; and, secondly, that all the timbers designed to make the sides of ports are, or should be, continued if possible, without scarphing, up to the top of the side. Those timbers, however, which lie in the sudden turn of the body, having too great a curvature in their length, and others, which run up to the rough-tree rail, &c. having too great a length to be otherwise obtained, must be admitted to scarph.

In the turn of the body, forward and aft, as the frames are canted, there is the less compass or curvature in them, and the bevellings or angles approach nearer to a square, which is, of course, the more favourable to conversion. The stations of the timbers being kept at the main breadth, in order to give them their proper cant, contract the room and space on the dead-wood, and reduce the heels of the timbers accordingly.

The frame timbers are formed into bends, in the manner that we have already shewn, by the union of the first futtocks, second or middle futtocks, third and fourth futtocks, with top-timbers, which are severally joined together and bolted. Sometimes the frame timbers are fayed close together or separated for air; those that are separated have dry pieces of oak fayed between them in wake of the bolts.

In the disposition of the frames, at their several stations, they should stand, respectively, one on each side of every gun-deck port, by which the sides of every middle and upper-deck port are likewise provided for. Thus one fourth futtock and one long top-timber will form the side of every gun-deck port in two-decked ships, and the side of every upper-deck port in three-decked ships. A long top-timber and a fourth futtock will, in like manner, make the sides of the middle-deck ports in three-decked ships, and the sides of upper-deck ports in those of two decks.

All ships should be as light as possible in their upper works, consistently with the services for which they are intended; and, as the frame should not be incumbered with more short timbers than are absolutely necessary, two short timbers over the ports are sufficient to stand upon the sills, and so spaced as to receive the bolts of the deck standards above.

Those timbers that run up to make the sides of quarter-deck ports, forecastle ports, or to the roughtree rail, should, if possible, be made of timbers standing upon the upper-deck sills over the upper-deck ports. The side along the waist, between the ports, may be filled in with fir timber laid fore and aft, and dove-tailed into the frames.

The frame will be sufficiently full, and every purpose answered, when timbers are provided to form the gallery doors, and to fill in the quarters from the after frame to the side counter timbers; and, forward, from the foremost frame to the hawse-pieces.

All the timbers in the range of the main and fore channels should run up to the top of the side, and the filling timbers between each frame are all to be equally spaced between the frames; and, all the openings between the range of the chain and preventer bolts are to be solidly filled in with dry oak fillings, as are also those over every gun-deck and middle-deck port, that there may be solid boring in wake of the port-ropes, pipes, and muzzle lashing eye-bolts, also behind iron knees and standards.

All scuttles, row-ports, &c. should be considered in the disposition of the frame, so that the strength may not be reduced.

Beginning forward, we shall now endeavour to make every necessary observation in regular order. First, the hawse-holes may be transferred from the sheer-draught, as we have before shewn; then the height of the heads of all the timbers may be taken, above the base line in the body-plan, and set off above the upper edge of the rabbet, upon their corresponding timbers in the disposition. Curves being now drawn through the spots set off, will shew the heads of each timber in the disposition.

Next, square up in the disposition, the siding of all the timbers between the cant bodies, and, as the upper-deck ports are less fore and aft, than those of the gun-deck, the upper part of the frame timbers must be separated at the joint. It is customary, to open the joints of the frames from the side of the keel upwards, having dry pieces of oak fayed between them in the wake of the bolts.

We can now represent every timber; those in the fore square body as at ⊕, and those in the after square body as at (2) having a single timber to shift the floors at (1). Those in the fore cant body as at N, O, P, &c. and those in the after cant body as at 21, 22, 23, &c.

The fourth futtocks, being the longest timbers in a ship, and, from their shape, very difficult to be obtained of the whole length, especially for ships which have much tumble-home, or even long enough to run up so as to make the side of the upper-deck ports; particularly forward and aft, the sides of such ports; the method, therefore, that we would recommend to be adopted when such fourth futtocks cannot be obtained as will run up to the top of the side, is, to scarph them together with a hook and butt, giving shift to the port and each other; or, if preferred, a side scarph.

The third futtocks, that come under the gun-deck ports, are to be continued upwards to the underside of the sill. But, when the third futtocks, owing to their great compass, cannot be obtained so long, they must be scarphed, observing always to get them longer than the regular shift.

The port-sills may next be drawn: the upper sills deepest where the preventer bolts are likely to come. Then the blocks through the side may be represented, that long timbers may not be provided, and afterwards cut asunder by those blocks.

The foreside of the side counter timber may be drawn in from the dimensions, and the gallery doors set off from the sheer draught; then the sills and all the timbers necessary to frame the quarters abaft the after frame.

Having provided for all the ports, &c. thus far, it should next be contrived that the timbers which run up aft and forwards to make roughtree timbers, timber-heads, or the sides of quarter-deck and forecastle ports, should be those short timbers that stand upon the upper sills of the upper-deck ports; and, for roughtree timbers, those over the quarter-deck ports: as it should be the utmost care of every constructor to design every timber to the shortest length admissible; as, in a disposition of this kind, he has every opportunity of so doing; and likewise of pointing out, and converting to the best advantage, the most scarce and valuable timbers.

Lastly, the section abaft the stern-post, in Plate I. represents the thwartship appearance of the air-funnel in the opening of frame 10. These funnels have been found very convenient for carrying off the foul air from between decks, and may be placed wherever convenient, between the openings of the timbers; so that there be no obstruction; but, that the air may pass upwards freely either to the undersides of the sheer-strakes, in the waist, and undersides of the lodging-knees elsewhere; openings being cut through the inside stuff, about two inches deep, and as much fore and aft as the openings. Advantage of the largest openings should always be taken for their admission.

All that is required in fixing the funnel, is one sill, let in between the timbers at the underside of the gun-deck lodging knee, or upper deck in frigates, &c. and another at the underside of the sheer strakes in the waist, or underside of the quarter-deck or forecastle lodging knees, as they are shewn in the section. The openings may then be paid with pitch, tar, or rosin.

EXPANDING THE BOTTOM AND TOPSIDE.

Before we proceed to the expansion of the planking, it becomes necessary to make some remarks on planking in general; as the planking of a ship is a branch so very material, that, unless it be judiciously performed, it will inevitably be very injurious to, or subversive of, those good qualities that might be expected from the superior construction of the ship. The planking ought, therefore, to be particularly well performed; as, in the joining, or proper shifting, fastening, and caulking, the goodness of every part of the materials for that purpose should, consequently, be very carefully inspected.

The length of plank is a very great object to be considered; and, in the shifting, it is principally to be observed: for, if it cannot be worked up to the wales with the length begun with, (that is, the regular shift kept up,) it will make very bad work, and not be so strong upwards as below. It is allowed, and hath generally been found to answer, that if three whole planks be wrought between every two butts, and all the butts overlaunch, or be in distance from each other, six feet, the planks will be only twenty-four feet long, and the work reckoned very good. We may, however, have a very bad shift, and yet have three strakes between every two butts on the same timber: that is, when the butts rise one above another in a regular manner, like steps; for, as the upper butts, or those in the topside, are the most likely to give way, all below would be inclined to follow; for, if the ship begins to break her sheer amidships, it is most probable that the butts afore and abaft would yield proportionably; therefore, let one of the butts between have a double shift, to extend twelve feet; then will the stepping of the butts, which we have mentioned, be prevented, and the planks be twenty-four feet long. As the work will thus be sufficiently strong, this is the rule which is generally followed for ships of every class in the royal navy. But, as oak plank, having sufficient breadth at the tops in that length, has become exceedingly scarce, merchant ships have the plank shifted of various lengths, according to its thickness, as may be seen in Plate III. and by referring to the table of dimensions hereafter.

The Wales must be wrought of such lengths, and the butts shifted, so as to give the strongest shift to the ports and each other; and, to assist conversion, may be wrought anchor-stock, or still more so, by being wrought top and butt. When the wales consist of four strakes, they have a fair seam in the middle.

In determining on the shift of the wales, some of the midship pieces should have a three-port shift, that is, should overlaunch three ports, being careful in large ships to make one butt answer for the pump dale scupper.

If the wales are to be wrought in three strakes, let the two lower strakes be worked top and butt, and the upper strake of a parallel breadth.

The Thickstuff, or diminishing strakes, from the lower edge of the wale to the thickness of the bottom plank, being of English oak, is wrought top and butt; and should be shifted from the butts of the wales to the regular lengths of the bottom plank as soon as possible.

The Plank of the Bottom is English oak plank, as low as the light-water mark, which is the third water line in Plate III.; and, below that, may be East-country plank of the best quality. The English plank is worked top and butt to twenty-four feet lengths at least in ships of war. Now, to break the shift, so as to work East-country plank to advantage, requires care; for, as just observed, the general shift of English plank is twenty-four feet, whereas East-country plank is from thirty to fifty feet; consequently, the best way is, to work a double shift at first, or one of forty-eight feet in length. It rarely happens that the shift is broken from English plank to East-country plank without introducing two planks between two butts on the same timber in some places; and, it may be admitted, owing to the superior length. Be careful, in shifting the East-country plank, to keep the shift as nearly equal as possible, not being confined to butt on one timber; but, to make an advantage of drawing the butts having no less than six feet shift.

East-country plank, from ten to eleven inches broad, is wrought with fair or parallel edges, excepting forward and aft; for, it must be observed always to have English oak plank for the foremost and aftermost shifts. Four to six strakes next the keel may be of elm or beech. The edges, and butts of those in East-India ships, are rabbeted close; and fine flannel, dipt in tar, is put between.

Let it also be observed, in shifting the butts, to keep them clear of the scarphs of the keel; and, likewise, that no butt is placed under the pumps.

In planking the foremost end of the bottom, the breadth of the strakes must be considered, and also the shape of the bow, that every strake of plank may be brought into the stem; and every plank should be kept from snying as much as possible. But, in full-bowed ships, such as have long floors, and a round or full harpin, it would be impossible to bring every strake to the stem without too much sny. It is therefore customary to work, in the bow of such ships, a steeler next under the wale; and, at every fourth or fifth strake next under it: by which means all the strakes that come to the stem will be of sufficient breadth. In order to take the any out the more, bring the steeler well forward; the more so the better. In most ships a drop strake, or steeler, under the wale abaft, assists the planks very much in working at that sudden part of the ship.

To produce fair edges and facility in working the planks, let the after ends of those near the keel be worked broad; indeed they cannot be worked too much so, in order to bring their edges straight, and out of winding.

The Plank of the Topside is generally wrought in parallel breadths; therefore it had better not be more than eight inches broad, or thereabouts. The topside being cut by the ports, drifts, &c. requires the greatest strength to be given to it in shifting the plank; as no butt should be placed over or under a port unless there are two planks between. The planks in wake of the main-mast should have a three-port shift. The others, afore and abaft, may have a two-port shift. As it is rather stronger, to butt between the ports, it may be allowed sufficient to have a shift of five feet six inches where a plank comes between; or, five feet where two come between. But there should not be less than six feet shift where no plank comes between. The channels and sheer-wales, in large ships, should work down to the stops of the ports in midships; and, where the sheer lifts forward and aft, should work down to as many ports as may leave sufficient stop, and afford wood to receive the port hook, letting the wood so worked down be continued six inches each way beyond the stops of the ports: thence snape back about nine inches; but, by all means, let planks run through, if they hold but five inches after the stops are cut, so as the hooks will clear the seam; for planks, however broad, working down to the ports, make that part no stronger than any other.

Forward, in wake of the hawse-holes, the planks should be so wrought as to have the seam come in the middle of the holes; and care must be taken that no seams come behind the cheeks.

The Sheer Strakes, as they are the greatest strengtheners of the topside, should have their butts disposed with the utmost care, in order to produce the greatest strength between the drifts, and give the very best shift to each other. They are wrought of parallel breadths, with hook and butt scarphs, about four feet long, between the drifts. Those afore and abaft may be square, especially behind the channels, which must be of English oak. The others, owing to their great lengths, must be of East-country plank.

Shifting the butts of the inside planking requires this consideration; that the strings along the waist, and the upper-deck clamps and spirkittings, should give shift to the butts on the outside.

All clamps and spirkittings above the lower gun-deck should have three port shifts in midships. All clamps should be wrought with hook and butt scarphs, about four feet long; spirkittings should be wrought top and butt, or anchor-stock, so that no butt shall come behind the riders. One butt is to come in wake of the pump dale scupper.

Clamps of two and three decked ships, above the gun-deck, are sometimes wrought in two strakes. Spirkittings are wrought in three strakes, and tabled into each other.

The clamps of the lower deck cannot be wrought towards the after part of the ship agreeably to the range of the deck, so as to admit of the beam's coming home to the timbers, as it would be found to wound them too much, or produce too great a sny; therefore, the clamps must lift quite aft, with an easy flight, and some of the after beams, of course, must come on the clamps.

TO EXPAND THE BOTTOM AND TOPSIDE.

The expanding of the bottom and topside, upon paper, so as to be certain of the lengths and breadths of the planks, together with the mode of disposing of the butts to the greatest advantage, although attended with some trouble, is much more advantageous than trusting to shifting them on the ship's side; for, when the ship is planking, it is necessary to gird the body in a number of places, in order to see what number of strakes the bottom will require, that the planks may be worked of an equal breadth, and fairly diminished forward and aft. To do this, with precision, staging and much trouble is required. But, having the bottom and topside expanded before you, upon a plane, and knowing the general lengths that your planks will work to, you can more conveniently shift the butts, according to the foregoing directions, or alter any one where the length cannot be obtained without difficulty or without making bad work; which could not be so easily performed on the side of the ship.

The bottom may be expanded by the ribband lines or water lines, when parallel to the keel. The bottom, as represented on Plate III. is expanded by the water lines, as they are generally drawn on the draught.

Now, from the sheer-draught, Plate I. may be taken the stations of all the timbers, and the lower edge of the rabbet of the keel from the aftside of the rabbet of the stern-post to as far forward as the rabbet continues straight; likewise the scarphs of the keel; all of which are to be set off on the plan of expansion, as shewn on the plate, to intersect the said straight line. Then, to expand the square bodies, transfer the heights of the upper and lower edge of the wales, the sheer-strakes, upper and lower sides of all the ports, the height of the decks at the side, and underside of the plank-sheer from the sheer-plan, (Plate II.) to the body-plan. The wales, &c. are now to be drawn upon the half-breadth plan; which being done, pin to those lines narrow slips of paper, confining them by needles, from ⊕ forward and thence abaft; marking, upon each slip of paper, the station of every timber and its respective water line, &c. as girt.

In the same manner gird the timber ⊕ in the body-plan (Plate II.) from the inside of the rabbet of the keel to the top of the side; then, mark upon it all the water-lines, heads of the timbers, upper and lower edges of the wales, and ports; likewise, the decks at the side and underside of the planksheer. Then square up the station of ⊕, as shewn in Plate III.; and, upon that line set up the middle of the rabbet, to which spot, fix with a needle the spot on the slip of paper that girded ⊕, and is marked for the inside of the rabbet of the keel, laying the edge fair with the line ⊕ squared up; now, upon that line, mark off from the said slip all the water lines, the heads of the timbers, upper and lower edges of the wales, ports, &c. In the same manner must we proceed to gird every square timber in the body-plan (Plate II.), marking thereon the name of its respective timber. Then fix the point marked for the middle of the rabbet of each girt, to the middle of the rabbet of its respective timber (Plate III.).

Now fix the girth of each water line to its corresponding height as marked on ⊕ ; then stretch each girth, seeing that it does not pucker, in such a manner that the stations of the timbers, as marked on the girth of the water lines, &c. and the corresponding heights of the water lines as marked on the girth of each timber, exactly agree, confining them with a needle in that situation. At the intersection of each, make dots, which will shew the expanded heights and lengths of all the water lines, &c. in the square bodies. Fair curves may then be drawn through all those dots, which will represent the square bodies expanded.

TO EXPAND THE FORE CANT-BODY AND HAWSE-PIECES.

WHERE the water lines, wale line, toptimber line, &c. intersect the cant-timbers in the half-breadth plan, square them up to their respective lines in the sheer-plan (Plate II.) then transfer those heights from the sheer-plan to their corresponding cant-timbers in the body-plan, and then continue, downwards, the heels of the said cant-timbers as low, and as much within, the half siding of the stem, as the rabbet, when taken out may be supposed to cut into the side of the stem. Likewise continue downwards the joints of the cant-timbers in the sheer-plan (Plate II.) till they intersect the middle of the rabbet of the keel and stem. Then, with narrow slips of paper, as before, gird the several cant-timbers in the fore body, as shewn in (Plate I.) marking thereon the heel, where it cuts the inside of the rabbet, the bearding line, the heights of all the water lines, the lower and upper edges of the wales, the ports, &c. ; and, on the foremost cant-timber, the heights of the heels of the hawse-pieces, marking on each slip or girth the name of its respective timber. Then with other slips of paper gird round each water line in the half-breadth plan, (Plate II.); and mark thereon the joint of square timber M, and the joint of each cant-timber; likewise mark the intersection of each hawse-piece, also where the bearding line intersects the water line, and where the water line ends in the rabbet. The girth at the wales, port-sills, and top-breadth, must also be taken, and respectively marked on each girth or slip.

Now gird another slip of paper round the curve representing the rabbet of the stem and keel (Sheer-plan, Plate II.) marking thereon the square timber M, and the joints of all the cant-timbers where they intersect that line; mark, also, the height of all the water lines, the upper and lower edges of the wales, ports, &c. beak-head, and upper part of the stem.

Square up from the half-breadth plan, (Plate II.) where the heels of the hawse-pieces intersect the joint of cant-timber *s* to its thwartship appearance in the sheer-plan; and, then transfer those heights to cant-timber *s* in the body-plan; prior to taking the girt of that timber: as those points will give the heels of the hawse-pieces when expanded, as shewn in Plate III.

The slips or girths of the water lines are then to be stretched as before (Plate III.), keeping the spot of square timber M to its respective water lines already expanded on that timber. Then stretch the girth taken round the curve of the stem, fixing its spot M at timber M, as shewn in Plate III.; then, confining the heels of the cant-timbers to their respective spots on the curve of the stem, move the whole together, without puckering, till the foremost ends of the water lines exactly agree with their spots on stations on the stem; and, in like manner, till the spots made for the stations of the cant-timbers and water lines agree; fixing them with needles till the whole fore-body every where reconciles. Then mark on the draught (Plate III) the intersections of all the girths. Those from the timbers, when curves are drawn to the spots, will represent their moulding edges; as those from the water lines, when the lines are drawn, will likewise shew the water lines as expanded, then by setting off the scantlings of the timbers on each side of the joint, curves being drawn thereto, will represent the fore and after sides of all the timbers.

TO EXPAND THE AFTER CANT-BODY AND TRANSOMS.

The expanding of the after cant-body, as far aft as the fashion-pieces, is so similar to that of the fore cant-body, just described, as to require but little additional explanation.

When the after cant-body is expanded, the openings between the timbers may be shewn, by a faint shading; likewise the openings between the hawse-pieces and transoms when drawn, which now only remain to be described.

Where the moulding edges of the transoms intersect the foremost cant fashion-piece in the body-plan, take their distances, in the direction of the fashion-piece, from any given spot; then set off those distances in the direction of the aftside of the foremost fashion-piece (Plate III.) above and below the said spot. Then, where the buttock lines, 1, 2, 3, 4, and 5, in the body-plan intersect the foremost square fashion-piece, level them out to cross the foremost cant fashion-piece, and represent them by dots, and take their distances from the said spot, in the direction of the fashion-piece, setting off those distances from the said spots, in the direction of the aft side of the foremost fashion-piece, (Plate III.) which will give the stations of the buttock lines on the aftside of the fashion-piece.

Now gird slips of paper round the buttock lines, 1, 2, 3, 4, and 5, in the sheer-plan, and mark on them the sides of the fashion-pieces, the upper and lower edges of all the transoms, (noting the difference to prevent confusion), likewise the margin line where the buttock lines terminate.

Then, with other slips of paper, gird round the moulding edges of all the transoms; also their under sides below the wing-transom, in the plan of the transoms, marking thereon the several buttock lines, the foremost and other fashion-pieces, and inside of the rabbet of the stern post (which will shew the greatest lengths of the planks when expanded, or, as on the ship when wrought.) Then stretch the several girths of the transoms and buttock lines, as on Plate III. fixing the spots for the foremost fashion-piece to its corresponding spots at the aft side of the foremost fashion-piece. Then move the girths till their corresponding spots agree with those for the buttock lines and likewise with those for the edges of the transoms; and, confining them with needles, mark the intersection of each girt. Now, by describing curves through the respective spots, the edges of the transoms will be shewn, likewise the buttock lines where they intersect the transoms.

The utmost length of the planks round the buttock is now determined, by the margin line on the upper side; and, on the aft side, by the rabbet of the post on the girt of the transoms. It only now remains to complete the rabbet of the post to the keel.

Stretch a slip of paper up the rabbet of the stern-post in the sheer-plan, (Plate II.) then mark on it the upper and under sides of all the transoms, the water lines, with the lower edge of the rabbet of the keel. Then fix it on the plan of expansion, (Plate III.) keeping the spot for the lower edge of the rabbet, well with the rabbet of the post on the straight line; next removing the slip of paper till the spot for the water lines agrees with its water lines already there, fix a needle, and move the upper part of the slip, without puckering, till the spots for the transoms agree with their corresponding spots: a line being then described, to the edge of the slip, will represent the extent of the planks below the transoms.

The girts of the curves of the top-timber line decks, &c. above the main wale being expanded, in a similar manner, will give the boundary of the topside to the rabbet of the stem forward, and to the aftside of the stern-timber abaft; as, likewise, the upper and lower edges of the wales, ports, &c.

The whole side being now expanded, from the keel to the topside, the planks may all be shifted agreeably to the foregoing observations; beginning with the main wale, or the strakes between the wales and the ports, as they must give the strongest shift possible to the ports and to each other. The sheer-strakes, as before observed, should be scarphed with a hook in the middle, and be so disposed as to give the greatest strength to the drifts and each other: the strakes between the wales and sheer-strakes may be next divided, as to their number and breadth; and, if the lower strakes, or those nearest the main wale, are the broadest, and gradually diminish in breadth upwards, they will be more easily obtained; as they are thicker, and make the topside look better.

The plan which we have described is the only method of ascertaining what planks are the most proper to work up or down to the ports, and which to cut upon; for, till this is determined, there can be no certainty in shifting the butts; because, if those planks which must be cut by the ports, should be found to be cut too much, or that it should appear better to work to the ports with the strakes next them, then, to avoid bad work, or introduce very long planks, some of the butts will want shifting. Here may be seen the great utility of expanding the topside; for, if these things are not considered before the work be too far advanced, an indifferent shift will probably ensue.

When there are three strakes between any butt, over or under a port, the butt had better be brought to fasten upon the frame that makes the port.

The longer the planks are shifted, the stronger will be the topside; but the general length of planks must ever be considered; because, when the ship wants repairing, planks must be cut on purpose, and green planks will be worked where seasoned planks only ought to be used. We have been the more particular in explaining the shift of the topside, because the strength of the sheer, in every ship, depends, principally, upon the shift of the planks above her seat in the water; and, as the butts of the clamps and spirkittings should be shifted as clear of the butts on the outside as is possible.

N. B. To obtain the expansion of the foregoing lines, those not now remaining on the draught were inserted in pencil only.

INSTRUCTIONS FOR DELINEATING THE INBOARD WORKS, WITH OBSERVATIONS ON THE INBOARD WORKS OF SHIPS IN GENERAL.

Draughts of the outboard works being now constructed, and every part described requisite to the putting the ship in her frames and planking, we now proceed to form a draught of the cavity of the ship, or Inboard Works, in such a manner as to exhibit the arrangement and disposition of every thing therein contained, to the best advantage.

Sometimes the inboard works are drawn in the sheer-draught; but, when so drawn, they generally appear much confused; it is therefore the best and easiest method to appropriate a draught to that purpose, by which every particular will be more clear and conspicuous. And when this be drawn, the artist will not be under the necessity of working from his principal draught.

The Draught of the Inboard Works, Plate IV. of this work, will give the reader a correct idea of all the particulars which it is designed to exhibit. To this plate he will find it necessary to refer throughout the following instructions.

For the construction of the draught, take, in the first place, from the sheer-draught, the scale, stem, stern post, counter timbers, keel, cutting-down line, keelson, apron, transoms, fashion-pieces, decks, and centres of the masts; also the drifts, plank-sheer all fore and aft, the joints of the frame-timbers, and the ports, which will be found to be all that is necessary for our present purpose.

The beams come now under consideration, and should be so disposed as to come one under, and one between each port, or as near as can be to answer the other works of the ship, as the hatchways, ladderways, &c.; but, where it happens that a beam cannot possibly be placed under the port, then a beam arm should be introduced to make good the deficiency.

To draw the beams in the draught; take the moulding of the lower deck beams from the dimensions, and set it off below the line representing the deck at the side; then draw a fine line in pencil parallel thereto, which will represent the under side of the beams: in the same manner draw the underside of the beams for the upper deck, quarter deck, forecastle, and roundhouse; then take the siding of the lower deck beams, and place one under, and one between, each port, all fore and aft, only drawing them in pencil.

Set off the main hatchway, fore and aft, as in the table of dimensions, before the beam that forms the main mast room; the aftside of this beam then forms the foreside of the hatchway; this beam may be now drawn in ink. And a beam-arm must be introduced in wake of the main hatchway.

The fore hatchway may now be determined, the foreside of which should range well up and down with the after end of the forecastle, and fore and aft as in the Table of Dimensions. At the foreside of the fore hatchway, the rest of the beams afore the fore hatchway may remain as first placed, if the riding bitts will admit of it; then determine on the after hatchway, the fore side of which comes abaft the main mast room.

The size of the ladder and hatchways must be governed by the beams, as when there is once a good shift of beams they should never be altered for ladder and hatchways, unless for the three principal hatchways, which must always be of a proper size, according to the size of the ship, as given in the Table of Dimensions.

The after or main jear capstan must be placed between the two hatchways last described, and the beams abaft may stand as they are already placed, recollecting only the situation of the mizen mast.

The riding bitts or windlass may now be placed, letting the foreside of them come against the aftside of a beam, and the foreside of the foremost ones against the next beam, but one forward. The deck breast-hook should also be drawn, which may be as broad as can be gotten the moulding way, and sided agreeably to the dimensions.

The gun or lower deck-beams, knees, &c. being described, we shall now proceed to the upper deck; the precautions already mentioned in spacing the beams must be taken, upon all the decks that have ports; only observing to keep the beams upon one deck as near as can be over the beams on the other, for the convenience of pillaring, as they will then support each other.

The hatchways are now to be considered, placing them all exactly over those on the lower deck, so that, consequently, where there is a beam arm on the lower deck, there must likewise be one above it on the upper deck, and the same on the middle deck in the three decked ships. It commonly happens, in ships of the line, that there cannot be a whole beam between the deck breast-hook and the beam that supports the step of the bowsprit, because the bowsprit passes down through that place; when it so happens, a beam arm must be so placed as to let the end come equally between the beam and the breast-hook; but, in ships whose bowsprit will allow of a whole beam, the ports and the rest of the beams must be consulted, in order to space it; and, when it so happens that the foremast comes in wake of a port, a beam arm must, necessarily, be introduced.

Having spaced the beams of the upper deck according to the disposition of the beams below, the ladderways should be so contrived, that in ships of war there should be one next abaft the fore hatchway, which is a single ladderway, and one next afore the main hatch, which is a double ladderway, the ladders standing the fore and aft way; and, likewise one over the cockpit, corresponding with that on the lower deck.

The next object to be considered are the capstans in line of battle ships; the after one is placed on the lower deck, and its barrel passes through the upper deck to receive the whelps and drumhead there, it being a double capstan. In three decked ships the upper part of the capstans is on the middle deck. Frigates, or small ships, have only one capstan, the upper part of which is placed on the quarter deck. The fore jear capstan should be fixed in the most convenient place to admit of its being lowered down to the orlop, out of the way of the long boat; therefore it may be placed abaft the ladderway at the fore hatchway. The beams on each side of it should be placed exactly over or under the beams on the other decks, and should be at a sufficient distance from each other to permit the drumhead to pass between them. The centre of the capstan should then be placed in the middle between the beams which compose its room, and the partners should be fitted in such a manner as to shift occasionally when wanted. The partners on the lower deck, wherein the capstan steps, must be supported by a pillar on the orlop deck, the lower part of which may be fitted in an oak chock, that fits in the step; so that, when the pillar and chock are taken away, and the capstan is lowered down, that chock serves as a step for the capstan; the two beams on the orlop, having the pillar and chock upon them, have, consequently, the whole weight of the capstan pressing downwards; and, for the better support of them, a carling should be placed beneath the fore and aft way, with three pillars, one under each beam, and one between. All these pillars should be stept in the keelson, by which the orlop deck will be well supported in wake of the capstan, and the other decks have no strain arising from it. In Plate III. the capstan is small and fitted with an iron spindle, and so constructed as to shift forward or aft when most convenient. The more laborious purposes of those sort of ships being performed by the windlass.

Now dispose of the fire hearth, which is placed differently according to the size of the ship; for, in three deckers, it is found most convenient to place it on the middle deck, which of course gives much more room under the forecastle than it would have, were the fire hearth there. In all two decked ships it is placed under the forecastle, because, on the main deck beneath, the riding bitts are in the way. In frigates and small ships it is fixed under the forecastle, though confined between the riding bitts; therefore, in such ships, it should be kept as near as possible to the after riding bitts, that there may be the more room between it and the foremost riding bitts, to form as convenient a galley as circumstances will admit.

The main-top-sail-sheet bitts next claim our attention, the foremost of which must be placed so as to have its aftside against the foreside of the beam abaft the main hatchway, and so as to pass down to the lower deck; and there step in the beam below. The main jear bitts must be placed against the fore side of the beam abaft the mast, and step on the beam below. The cross-pieces to the bitts should be on the foreside of the foremost bitts, and abaft the after ones, and should be in height, from the upper deck, about one third of the height between it and the quarter deck, or, as given in the dimensions. With regard to the heads of the bitts, we should consider the length of the ship's waist; and, if there is length enough from the forecastle to the foremost bitts to admit of the spare geer being stowed thereon, without reaching farther aft, the quarter deck may run so far forward that the head of the foremost bitts shall tenon in the foremost beam, which gives the main mast another deck, and admits of the quarter deck being so much the longer; but, if there is not the extent above mentioned, the quarter deck must extend no further forward than the after bitts, which will tenon in the foremost beam; the foremost bitts must have a cross piece let on their heads, which is termed a horse, and used to receive the ends of the spare geer.

We may now proceed to the quarter deck and forecastle. The length of the quarter deck being before determined upon, the first object presenting itself is the beams; therefore, in placing them, the different ladderways, gratings, &c. on the quarter deck should be consulted; observe that, it is unnecessary to have in the quarter deck, round-house, and forecastle, carlings or ledges (except carlings for the hatches.) But, having no carlings or ledges, the deck necessarily requires a greater number of beams, and a good round-up: otherwise it would be apt to bend with its own weight. The most approved rule, therefore, is, to have double the number of beams in the quarter deck, as in the upper deck in the same length. If heavy metal is intended to be used on the quarter deck, then it will, however, be necessary to frame it with carlings and ledges.

Proceed now to shift the beams to the greatest advantage, consulting the hatchways, ladderways, masts, bitts, steering wheel, &c. In respect to the ladderways on the quarter deck of all ships, there should be one near the fore part of the great cabin for the officers, and one on each side at the fore part of the quarter deck from the gangways. In every ship of the line all the beams from the ladderway to the four beams before it, should be open, with gratings, for the more expeditious conveyance of different things in time of action, as well as for air.

Two scuttles may be disposed, one on each side in the room abaft the main mast, (if the main mast happens to come through the quarter deck) for the top tackles to pass through, to hook to the eye bolts driven in the upper deck for that purpose. Scuttles are also to be formed on each side the mainmast for lifting the pumps, &c.

Now dispose of the steering wheel, which should be placed under the fore part of the round-house. The two beams of the quarter deck which come under it should be placed conformably to the two stantions of the wheel, so that they may tenon in them. It should be observed, that the beam abaft, which comes under the screen bulkhead, should round aft agreeably to the round of the bulkhead, for the support of the same. This bulkhead is sometimes placed abaft the gallery door.

The forecastle beams should be placed as the works of the deck, as the scuttles, &c. will admit. There should be a scuttle for the funnel of the fire hearth to pass through, another over the copper to give vent to the steam, and one or two over the galley, as the forecastle may admit. The fore-top-sail-sheet bitts should be so disposed as for one pair to come on the fore, and the other on the aftside of the mast, to let into the side of the forecastle beams, and step on the upper deck beams below. The after bitts are to cast at the heels so as to lead the tack clear of the galley. There must also be a ladderway at the fore part of the forecastle for the convenience of the fore part of the ship.

After these things have been considered, the beams may be placed agreeably to them, letting the number of beams be four more than there is in the upper deck, in the length of the forecastle; and, where there happens to be a wide opening between the beams, as at the mast room, &c. where a half beam is to be introduced, that will make good the deficiency. The foremost or cat-beam should be broad enough to take the aftside of the inboard arms of the cat-heads, as they are secured upon this beam by being bolted thereto; and, to take a five inch rabbet to receive the ends of the forecastle flat.

Now proceed to the Round-House, letting the same observations suffice with respect to the beams as were made on those of the quarter deck; for, as the round-house beams are sided less, they ought, consequently, to be nearer to each other; therefore, let the number of beams on the round-house be in number four more than in the same length of the quarter deck. The round-house should always have a great round-up, both for strength and convenience. Upon it there must be a small pair of knee bitts on each side of the mizen-mast, bolted through the mast carlings. It must also have a companion placed over the middle of the lobby, in order to give light thereto.

With regard to placing the round-house beams, we have only to attend to the foremost stantion of the steering wheel, and the mizen mast; as, when the beams which interfere with those parts are properly spaced, the rest may be disposed of at discretion, or at equal distance from each other, letting the beam over the screen bulkhead have a proper round aft, agreeably to the quarter deck beam underneath.

The upper parts of the inboard works being now described, we may proceed to the lower parts, or those which come beneath the lower deck; therefore in large ships draw in the orlop by taking the heights afore, amidships, and abaft, between that and the gun deck, from the dimensions, and drawing a curve to pass fore and aft, the upper part of the deck will be represented; then, setting off the thickness of the plank below the upper side of the beams, the under side of the plank will be represented also. But, as this deck does not run quite forward or aft as the other decks, we must next determine on the length of it; therefore, let the after beam be placed at a sufficient distance from aft, to admit of the bread room's being of a proper size for the ship, which will be under that beam of the gun deck that comes at the second port from aft.

The after beam being drawn in, proceed to space the other beams, placing them exactly under those of the gun deck, and that which comes under the second beam from forward of the gun deck may terminate the fore part of the orlop. Draw the limber strake, by setting off its thickness above the cutting down line, and drawing a curve parallel thereto, it will be represented.

The hatchways, &c. may now be represented on the orlop, with the main, fore, and after, hatchways, exactly under those of the gun deck.

The bulk-heads for the well may now be drawn from the lower deck beams to the orlop, and lowered; thence to the limber strake in the hold they are solid. The steps for the masts may be drawn in by continuing their centres down to the limber strake; and, also, two crutches abaft the mizen step, divided equally between that and the after part of the cutting down; the breast-hooks, in number, and size agreeable to the table of dimensions, may also be drawn below the lower deck hook, and all equally divided between that and the fore step.

Thus will every part of the Inboard Works be described in profile, together with the outboard works, and the body and half-breadth plans. It therefore remains for us only to add an explanation of the methods made use of in constructing plans of the decks, &c. in order to exhibit the various apartments and accommodations to be erected in the internal completion of the ship, which is, consequently, given in the following section.

INSTRUCTIONS FOR DELINEATING PLANS OF THE DECKS, &c.

First take, from the sheer-plan, the heights, at every timber, of each deck at the side, and set them up square, or transfer them, from the base line in the body plan to intersect their corresponding timbers represented by the ticked curves in the body-plan, Plate.I.

Then, upon the paper for each plan, draw a middle line; and, from the sheer-plan, square up the stations of all the square timbers. Next take, from the body-plan on Plate II.; the half-breadth of each timber at the height of the deck intended to be drawn; set this off, on each side of the middle line, at its respective timber and plan; then square down, from the sheer-plan, where the deck intersects the aftside of the stem and fore-side of the stern-post, at the rabbet, upon the deck plan; and, on those lines, set off half of the thickness of the stem and stern-post. A curve drawn through those spots will give the boundary of the deck to the out-side of the timbers. Within this line set off the moulding or substance of the timbers, and it will give the line by which the length of the beams will be determined.

Upon each plan square down, from the sheer-plan, the fore and aftsides of all the ports; and from the profile, (Plate IV.) the foreside and aftside of all the beams; then square them athwart from the middle line.

As the fittings up on each deck are very different, it becomes necessary to describe each deck separately. But, as the sides of all are nearly alike, it has been deemed sufficient, in our draughts, (Plates III. and IV.) to give one side only. Wherever there is a difference, it will be found described in these instructions.

To the middle line of the plan of the GUN, or LOWER DECK, (Plate IV.) square down, from the profile, the centres of the masts, the windlass cap-stans, pumps, riding and other bitts, hatchways, ladderways, scuttles, and riders.

Draw in the mast partners, placing them on each side of the middle line, agreeably to the dimensions; and, at the mizen mast, the step only. Draw in the riding bitts, on each side of the middle line, with their cross-pieces, according to the dimensions, likewise the standards, the foremost of which form the partners of the foremast. Before the foremast is the manger, which should be as large as possible, reserving room for the foremost gun, and of sufficient height under the bowsprit. Now draw in the bowsprit step close before the foremast partners. Then draw in the framing of the fore hatchway, and the ladderway before it, agreeably to the dimensions. The partners of the fore jear capstan may next be drawn, placing the coamings equally from the middle line, and sufficiently clear for lowering the capstan freely between them.

The main hatchway may next be framed, agreeably to the dimensions.

The main jeer and top-sail-sheet bitts are to be represented in ships of war, so that their insides may plumb with the centre of the pumps. The inner cases of the pumps must not wound the main partners more than can be avoided. The rhodings and winches of the pumps and pump-pillars may next be drawn. The step and pall rim of the main jear capstan and the framing of the after hatchway.

On our plan of the lower deck, Plate IV. we have endeavoured to shew the nature of framing the deck, and have likewise represented the knees.

The Carlings are also shewn in tiers, as directed in the table of dimen-sions; as, likewise, the ledges.

The plan of the UPPER DECK, Plate III. comes next under consideration, therefore, on this plan, square down to the middle line, in the first in-stance, from the profile, the centres of the masts, the capstans, the bitts, hatchways, ladderways, &c.

On the plan of this deck draw in the plan of the beak-head, as on the half-breadth plan, Plate I. thus: first, draw in the collar beams or carlings at the height of the beak-head, to its siding abaft the fore part of the beak-head, upon which draw in the stantions; observing to keep the two outer stantions to the size of the round-houses, and so that they may be kept far enough out for the funnel to come clear of the side. The third stantion from the middle line must be spaced so as to make the bow-chase port. The next stantion within makes the head door; and, the stantion next the middle line is made by the large stantion into which the collar carling is tenoned. On the midship side of the head door is a scuttle over which a flap is hung. The fore tack leads on board through this scuttle to the capstan, occasionally.

The partners of the foremast may next be drawn in the same manner as the main part runs on the gun deck.

The fore hatch and ladderway, as likewise the partners or steps of the capstans, may be represented; also the ladderway and main hatch, the main mast partners, and after hatchway, as directed in the table of dimensions, likewise the partners of the mizen mast.

Upon the plan of this deck the flat is shifted, having strict regard to the lengths. The flat of the deck, close to the side, in ships of war, is oak, which is shifted in suitable lengths from twenty to four and twenty feet, and anchor stocked, or else top and butt, to assist the conversion of the top end. Between the riders the waterways and first strake are consequently cut off, and abaft the riders are two iron standards.

From the deck transom to the aft part of the forecastle, excepting next the side, this deck is laid with deal; and much waste would be made if the butts were not correctly shifted to their lengths, which will be from thirty-six feet to forty feet.

The butts of the binding strakes are to be so disposed as to give as much shift as possible to the hatchways. The binding strakes may be of East-country plank, as English plank can hardly be procured of the lengths required.

Upon this plan is to be drawn the plan of the breast rail and foot rail, with their stantions.

On each side of the main mast, is framed a flat scuttle through which the pumps, &c. may be lifted; and, abaft the mast, is drawn the brace-bitts. Abaft the brace bitts, on each side, is a scuttle made use for leading the main top-tackles to an eye-bolt in the upper deck.

The framing of the gratings and ladderway may next be drawn, as directed in the table of dimensions; and, abaft these, the bulk-head of the captain's cabin.

There will be no occasion for a drawing or plan of the round-house; as, besides its beams, there are only the mizen-top-sail sheet bitts, a companion over the captain's cabin, and the steering wheel, if the rudder head is chosen to run so high.

GENERAL EXPLANATION

OF THE

METHODS OF LAYING-OFF, OR OF TRANSFERRING THE LINES OF THE SHEER-DRAUGHT AND OTHER PLANS, TO THEIR TRUE DIMENSIONS ON THE MOULD-LOFT-FLOOR, PREPARATORY TO THE ACTUAL BUILDING.

WE have already shewn, in a full and copious manner, the methods of delineating the Sheer Draught and other plans of a ship. Now, as *laying-off* in the mould-loft is, in fact, a delineation or expansion of the same plans upon an enlarged scale, the principles of each are similar; yet it is to be observed, that the present subject will not admit of a clear explanation, without the aid of a set of plates upon a scale too large and expensive to be admitted into this work. We are therefore, in this case, under the necessity of referring the reader to the "*Elements and Practice of Naval Architecture,*" noticed at the conclusion of this volume, in which this subject, with all its ramifications, will be found most clearly and fully explained.

From a draught designed upon paper, for the purpose of laying it down, and expanding it to its full size, on the Mould-loft Floor, we must, in the first instance, take off all the dimensions for laying off the body: and, in the manner that we have shewn, with respect to the dimensions of bodies in the construction of the draught, take off what scantlings may be wanted, which will be found in the table of dimensions. These are to be entered in a small book; for, were the draught used upon the floor, it would disfigure it very much.

It may, perhaps, be necessary here to premise a few observations relative to the transferring of lines from one plan to another. The three principal plans are denominated *sheer-plan, half-breadth plan*, and *body-plan.* In order to facilitate the laying off, and to prove the fairness or correctness of the various curves, certain operations are performed, in which the lines peculiar to one plan are transferred to, or shewn upon, another plan. Thus the lines on the body-plan are transferred occasionally, some to the sheer-plan, and some to the half-breadth plan; those of the sheer and half-breadth plan are, in like manner, sometimes transferred to the body-plan: but there is very seldom any occasion to transfer the lines of the sheer-plan to the half-breadth plan, nor those of the latter to the former. The sheer-plan is intended to exhibit heights and lengths on a perpendicular plane or longitudinal section. The half-breadth plan exhibits half the breadth of those heights and lengths on a horizontal plane; and the body-plan is compounded of heights, breadths, and lengths, on a perpendicular or transverse plane. The lines of the sheer-plan are transferred to the body-plan by means of their heights taken at various parts on the sheer-plan, and those same heights, measured off as heights upon the body-plan from the base line. If those heights are set off successively along the base line in the body-plan, they form curves, as, the main-breadth and top-timber line; or diagonals, as the ribband lines; if they are set off above the base line, in succession, on the same vertical, they ascertain the places of other lines on that vertical, as the buttock-lines ascertain the places of the timbers. All horizontal lines on the sheer-plan will be horizontal on the body-plan, as the water lines when parallel to the keel.

The lines of the half-breadth plan are transferred to the body-plan by means of their distances taken at various parts from the middle line on the half-breadth plan, and those same distances measured off from the middle line of the body-plan, either in a horizontal or diagonal direction. If measured off successively along the middle line, they form curves as the boundary of the floor sweeps. If measured diagonally, they ascertain the places of other lines on that diagonal, as the timbers are by the diagonals. All lines parallel with the middle line on the half-breadth plan are equally parallel with, and equidistant from, the middle line of the body-plan as the buttock-lines.

Mould-lofts are seldom long enough to admit the laying off of any large vessel in one length; in small mould-lofts they must, of course, lay off in three or four lengths. To lay off in one length would also cause unnecessary waste of time, for many of the perpendiculars of the fore-body answer alike for the after-body also.

The Mould-loft Floor being cleared, we begin by striking a straight line from one end to the other, in distance from the side of the loft about as much as the keel is deep, if it will admit of it.

This line will represent the upper edge of the rabbet of the keel, in the sheer and body plans, above which all heights are to be set up; and, it will represent, also, the middle line of the half-breadth plan.

Now, upon this line set off and erect towards the right hand, the foremost perpendicular; from the foremost perpendicular set off the station of dead-flat, and two or three timbers abaft it. Then strike in the intermediate perpendiculars representing the joints of the frame timbers taking their *Room* and *Space* from the draught or table of bodies.

Having erected the perpendiculars, or joints of the frame timbers, the stem may be represented in the sheer-plan, and the square bodies laid off according to the method before described, for drawing the sheer draught: nothing more being requisite, than to enlarge them to their full size on the floor.

The moulds for the timbers of the square body being made, the bevellings may be taken, as till then the timbers which have bevellings cannot be cut out. It is a custom with some to have only two bevelling boards, one to each body, and so making them very long in order that they may take all the bevellings, but this is a very unhandy way in large ships, where a great number of people are employed, and being so very confused, occasion a great many mistakes. Others will have a bevelling board to every ribband and head, which is altogether as unhandy as the former method; for then, when they want the bevellings for one futtock, they have to fly to six or seven boards before they can have them, besides sometimes taking a wrong board by mistake, and by that means spoiling the timber. Therefore the method we recommend would be, to have one bevelling board for every futtock, and likewise one for the floors, each containing every square timber in the body; the fore-body might be marked on one side, and the after-body on the other; then to take the bevellings for a floor, or a futtock, it would only be to look for the floor or that futtock bevelling board, where the bevellings would all appear regularly one after the other at one view, for their respective timbers, which might then be taken off with little trouble, and it would then be impossible to make a mistake, unless one timber were taken for another.

Provide a bevelling board for the floors, in breadth as much as the floor timbers are sided, and in length sufficient to take all the floor bevellings thereon. The first bevelling to be taken is from the cutting down line: therefore, beginning at dead flat, we shall find that to be a square, and also all the other midship timbers, which may be marked as such upon the board; then, apply the stock of a bevel to the next timber abaft the midship ones, keeping it beneath the cutting down line, and place the tongue of it well with the cutting down line, and that will give the bevelling for that timber; and proceeding the same with every other timber, all the bevellings may be taken, and may then be marked on the board, distinguishing them by writing their respective names upon every line; these bevellings will all be standing both in the fore and after bodies, and are for the purpose of trimming the throats of the floors.

In the next place, the bevellings for the outside of the floors must be taken, which are always under bevellings in both bodies, in consequence of the floors being always placed on that side of the joint that the body declines; those bevellings are the lower diagonal floor-ribband, and floorhead; and in order to take them from the body plan, proceed as follows; the bevelling board being parallel, set off the breadth of it square from each timber aft, on each of the floor diagonals in the half-breadth plan; then, take the distance of each spot set off from the middle line of the half-breadth plan, and set them off on their corresponding diagonals, from the middle line in the body plan, making of spots; then take a pair of compasses, and place one foot in each of these spots, and sweep the other till it touches the nearest place of its corresponding timber, and the radius of that sweep will determine the bevelling of the timber at that place where taken, and shew how much it is under, or within a square, in the breadth of the bevelling board; the bevellings may then be taken in that manner for every sirmark upon every floor timber, and from thence may be marked on the bevelling board.

In the next place, provide other bevelling boards, one for each futtock, and one for the top timbers, observing to let the breadth of each be the siding of their respective futtocks or toptimber; then, in order to take the bevellings for each, we must act as before described for the floors, only observing which futtocks are standing bevellings, and which are under; as those which are standing the breadth of their bevelling board must be set off on the diagonal lines in the half-breadth plan, at the foreside of the timber for the after body, and the aftside of the timber for the fore body, and *vice versâ* for those which are under. (*See Second*

Futtock Diagonal in the Body and Half Breadth Plan, at Timber 24, Plate I.)

Therefore observe, the floors are under, first futtocks standing, second futtocks under, third futtocks standing, fourth futtocks under, and top-timbers standing, bevellings; the bevellings for which, at every diagonal and every timber, may now be taken, and marked on their respective boards, placing one body on one side, and the other body on the other.

The most essential particulars of laying-off, with respect to the cant-timbers, differ from, and are not explained in, the methods of draughting heretofore given; but the principle admits, notwithstanding, of a verbal description; and, as this is a very material and essential branch of the art, we annex the following description and instructions with regard to this and some other operations, which will, we doubt not, be highly acceptable to the young practitioner.

OF THE CANT TIMBERS.

In order to comprehend, clearly, the nature of the cant timbers, observe, firstly, in the half-breadth plans of Plate I. where the cant timbers intersect the middle line, at which place suppose them hung in a moveable manner, (as a door upon its hinges) and also suppose the line drawn for the cant timber *u*, to represent the upper edge of a large surface, the breadth of which shall be equal to the line of the cant timber, from the top of the ship to the upper edge of the keel; and, supposing the horizontal view of that surface to be represented by that one line, it immediately follows, that the surface must stand perpendicularly from the upper edge of the keel. If, therefore, we draw the proper shape of the cant timber, according to the shape given in the body plan, upon this surface from the keel to the top of the side (not moving its position) and then cut it out, we shall have the true position of the cant timber as in its place on the ship, which will stand in a perpendicular direction. We may also, (supposing it to be hung,) swing it either forward or aft, and it will still maintain its perpendicular direction.

The canting of the timbers is of great utility, as it contributes very much to the strength of the ship in the fore and after parts; and, likewise, greatly assists the conversion of the timber. For, in the first place, by canting the timbers gradually from a thwartship line, we thereby bring each timber nearer to a square with the planks of the bottom, which is not only better for the security of the planks, but the timbers are also more able to bear that security. And, secondly, were all the timbers to be placed square, as those of the square body, though the scantlings of the timbers on a square should be equal to the scantlings of the timbers if canted, yet the bevellings of the timbers will be so great, that the consumption in some places, in order to get the timbers clear of sap, would be greater by one half than that in the timbers which are canted.

TO LAY-OFF THE CANT TIMBERS.

The cant timbers may be taken from the *Sheer Draught (Plate I.)* and represented in the half-breadth plan. on the floor, both for the fore and after bodies; their room and space, on the main-breadth line, may be governed by that of the square timbers; the sides of the ports being considered; but at the heel or middle line in the half-breadth plan, they should be placed as near together as they conveniently can be, in order to make the bevellings of the timbers as near a square as possible.

We shall take the fore body *(Plate I.)* and explain the method of laying them off by water-lines first, as that is the easiest way (supposing the water lines to be parallel with the keel) and best for the student to begin with.

The greatest attention is requisite, in order to prove that the extremities of the ship make fair lines on the half-breadth plan, as they cannot be altered after the cant timbers are run. Strike some horizontal lines across the body plan similar to the water lines in the Sheer Draught, Plate I. Then lay a thin batten well with each line so struck, keeping one end well with the middle line, and mark off all the timbers upon it; *i. e.* one or two beyond each cant body; then set off the different spots from the middle line on their corresponding timbers in the half-breadth plan, and by letting curves pass through those spots, the water lines will be formed in the half-breadth plan: with respect to ending them, that is performed in the same manner as the diagonal lines are ended, only with this difference, that where the half-breadth of the stem or stern-post is taken in the direction of the diagonal line in the body plan, for it is taken level, in consequence of their level direction the lines being run and made fair, we may now see if the body requires an alteration; and, if any of the timbers should be found either too full or too sharp for the water lines, they must be altered agreeably thereto, acting with the greatest care and circumspection, in order to preserve the true shape of the body as near as possible; we may also prove the heels of the square timbers in the after body, that they may want no alteration hereafter, which must be done by the bearding line; therefore, set off from the middle line in the body plan, the half thickness of the outside of the after dead wood, and draw a line parallel from the middle line, from about the height of the wing transom, down to the base line, and this line will represent the bearding in the body plan; then fix a batten in the direction and well with this line, keeping the lower end well with the base line, and mark off on it the intersection of all the timbers, and then set them off from the line representing the upper edge of the rabbet, on their corresponding timbers in the sheer plan; a curve must then pass through the spots set off to break in fair with the foreside of the rabbet of the stern-post, which curve will represent the bearding line in the sheer plan, and the same must be performed in the fore body, letting the foremost end break in fair with the aft side of the rabbet of the stem aloft.

But, as we cannot be too particular in making those parts of the body fair, run the shape of one or two fictitious timbers equally spaced, between the touch of the wing transom, and, after timbers 36 in the after body, and one or two before timber X in the fore body, Plate I, (those parts of the body being proved fair the thwartship way or by the horizontal lines) proceed to run some lines to shew the shape of the body in the sheer plan; or fore and aft way, similar to the bearding line; draw in the body plan five or six perpendicular lines, equally spaced between the bearding line, and the touch of the wing transom, (which may be found by setting off the half-breadth of the wing transom in the body plan;) then, take the heights from the base line of the body plan, up those perpendicular lines as marked in Plate I. to where they intersect each of the timbers, and set them off from the upper edge of the rabbet on their corresponding timbers in the sheer plan; making spots. To end the buttock or perpendicular lines take off their distances from the middle line in the body plan, and set them off from the middle line in the half-breadth plan, striking of parallel lines; then, from where the buttock lines intersect the margin line of the wing transom in the half-breadth plan, square up spots to the margin line in the sheer plan which will give the true ending of those lines, then pin a batten to the spots set off, and, at the ending, curves will be formed representing the shape of the body as cut by those lines in the sheer plan. Then, if the horizontal and perpendicular sections produce fair curves, the timbers in the body will be fair, and, likewise, those parts of the diagonal lines in the half-breadth plan; but, if they require to be altered, the timbers in the body plan must be altered, and also the diagonal lines agreeably thereto.

Having proved the body to be fair, we may now proceed to lay down the joint of *u*, which being one of the foremost cant timbers, and much canted, will be the more easily understood. Take the distances on a batten, in the mould loft, from the middle line in the half-breadth plan, on the cant line representing the joint of *u*, to where each water line intersects; and transfer them to the body-plan, by setting them off from the middle line on each corresponding water line. Then where the cant timber in the half-breadth plan intersects the main half-breadth line, port sill line, or deck line, and top-timber line, square up these points to their corresponding lines in the sheer plan, making a spot at each intersection; at which places take their heights and transfer them to the body plan, striking horizontal lines, which will represent the main and top heights and those between, on which the respective half-breadth of the cant-timber is to be thus applied; take the main and top half-breadths, port sill, or what lines may be run between from the middle line in the half-breadth plan, in the direction of the cant line *u*, and set them off from the middle line in the body plan, on their corresponding heights just drawn. There may be one or two horizontal lines struck across the body plan, which may be taken off and run in the half-breadth plan, in the same manner as the water lines; after which, they may be taken off from the half-breadth plan, in the direction of the cant timber *u*, and from thence set off on their corresponding horizontal lines in the body plan. The deck line being run in the *Plate*, will suffice here in order to avoid too great a confusion of lines. The spots which are now set off, will give the exact shape of the cant timber, but it yet remains to find the exact keeling of it, or termination of the lower part.

Take, from the body plan, the distance of the bearding, or half-thickness of the deadwood, from the middle line, and set it off from the middle line in the half-breadth plan of the cant timbers, striking a straight line parallel thereto, which line will represent the bearding or half-thickness of the deadwood there; then, when the line of the cant timber *u* intersects that line, square it up to the bearding or stepping line in the sheer plan, which height transfer to the middle line of the body plan, drawing there a horizontal line; then, take the distance from the middle line in the half-breadth plan, to where the cant timber intersects the bearding line, in the direction of the cant line *u*, and set it off from the middle line in the body plan, on the horizontal line last drawn, which will give the spot where the heel of the cant timber ends; then, by forming a curve from that spot through all the other spots, the shape of the cant timber will be thereby represented in the body plan; and, by proceeding in the same manner with the rest, they may also be described.

This method of laying down the cant timbers is much the easiest, and attended with the least trouble; but, if done in this manner, the body ought to be laid down as fair as it possibly can be, and the water lines should be exactly conformable thereto; for, as the water lines lie in an oblique direction from the timbers, the least variation would cause a very great error in the shape of the cant timbers, when drawn in the body plan. We would not, therefore, recommend this method for the mould loft; for, as the diagonal and horizontal ribbands must necessarily be run, it will be much better to work from them, as the position of the diagonals are nearly square from the timbers, and therefore will be less liable to error; but the utility of understanding this method of laying-off the cant timbers by water lines, will be sufficiently seen in the following instance. When a draught is designed, from which we are going to build, we may examine the shift of the timbers, and may perceive some impropriety in the long timbers, which may excite a reasonable apprehension that the timber will not prove sufficient to work so long as the shift designed; the square timbers being much more hollow than the cant timbers. Then, the water lines being generally drawn in the draught, and the ribband lines omitted, we may, from the water lines, lay off the cant timbers in the body plan, as cant timber *u* (*Plate I.*) and thence be capable of judging how the long timbers will agree with the conversion of the timber, or, even supposing that the ribband lines were run in the draught, it would be much the quickest method to make use of the water lines.

To shew their thwartship view, and how they may agree with the ports, &c. square up, from the half-breadth plan, the intersection of each cant timber with the bearding line, water lines, main and top half-breadths, and port sill or horizontal lines between, to their corresponding lines in the sheer plan; the curves found through those spots will give their thwartship appearance at the joints, and their fore and after sides or sidings may be shewn by first striking lines in the half-breadth to their siding at the main-breadth, and equally dividing them at the middle line or heel, as at *u*. Then those sides squared up as before directed for the joints, and their thwartship appearance, will be obtained by forming curves through the spots thus squared up, as shewn by Cant Timber, Plate I.

TO LAY DOWN THE CANT TIMBERS BY THE HORIZONTAL RIBBAND LINES.

We now proceed to lay down the cant timbers by the horizontal ribband lines, which is a method most in practice, and that may always be depended upon. We shall therefore lay off the same cant timber as before in this manner, which will prove both methods to be correct. Proceed to lay off the ribbands horizontally, in the following manner: Mark the distances square from the middle line in the fore body plan, where the upper diagonal or ribband intersects each of the square timbers as far aft as the foremost square timber of the square body (*Plate I.*) on a slip of paper or a batten, and then set them off from the middle line on their corresponding timbers on the half-breadth plan; then, by forming a curve through these spots, the upper horizontal line will be represented in the half-breadth plan; but, to end it, take the height where the ribband line intersects the half thickness of the stem in the body plan, and transfer it to the rabbet of the stem in the sheer plan; and, where that height shall intersect the fore part of the rabbet of the stem, square it down to the middle line in the half-breadth plan. Then, square from the middle line in the body plan, take the half-thickness of the stem, and set it above the middle line of the half-breadth plan, upon the line last squared down; from that intersection, with compasses, sweep an arch to the thickness of the bottom plank towards the middle line; the back of this arch gives the ending, and a line squared out from the horizontal ribband to touch the half thickness of the stem gives the appearance of the rabbet; by proceeding in the same manner with the rest of the diagonal lines, all the horizontal ribband lines may be described.

The horizontal ribband lines being now laid off, we may, in the next place proceed to lay off the cant timbers from them, and, as cant timber *u* laid off by the horizontal or water lines, has a great cant, it will shew the nature of laying them down this way the clearest. Therefore mark the distance in the half-breadth plan, from where the upper horizontal ribband line intersects cant timber *u*, square to the middle line, and set it off square from the middle line in the body plan to intersect the upper diagonal line; at which place, level out a line; then take the distance, in the half-breadth plan, from where cant timber *u* intersects the middle line, to where it intersects the upper horizontal ribband, and set it off square from the middle line in the body plan upon the line levelled out which will give the spot for the cant timber at that diagonal: and, proceeding thus with all the other horizontal ribbands, the spots for each will be given at their respective diagonal lines. The spots for the main and top breadths and lines between, and likewise the spot for the heel, may be found as before described. Then, by forming a curve through all the spots, the true shape of cant timber *u* will be described in the body plan, and by following the same method with the rest of them they may be represented also.

When the moulds are made and crossed, it must be observed, that the stations of the heads and arcs described, are where the lines levelled out intersect the lines of the cant timbers in the body, as marked level at cant timber *u*, Plate I. Then rase by, or nail a batten on, the mould, to cut off the heel to the stepping line, and side of the deadwood. To effect which, set within the bearding line, or half thickness of the deadwood on the half-breadth plan, and parallel thereto, the thickness of the stepping or heel, say three inches; then, from the middle line in the half-breadth plan, take the distance to the line last struck in the direction of the cant line *u*, and set it off from the middle line in the body plan upon the line levelled out for heeling the cant timber; and, from that spot, square up a line parallel to the middle line, which will represent the side of the deadwood, to which the batten is to be nailed as high as the cutting down, which will also give a spot for the inside edge of the cant timber.

The cant timbers in the after cant body are laid off exactly similar, and need not be farther described.

TO LAY DOWN AND TAKE THE BEVELLINGS OF THE CANT TIMBERS.

The cant timbers being laid down, we may, in the next place, proceed to take their bevellings. A bevelling board must be provided for every cant timber, both in the fore and after bodies; the breadth of the board may be as much as the siding of the third or fourth futtocks; and, of a length sufficient to contain all the bevellings which are abaft the joint on one side, and those which are afore it on the other, which will be as regular and complete a method as can be adopted. Then, to lay down the bevelling of any one timber, say cant timber *u*, as in *Plate I.* strike a line on each side of the joint in the half-breadth plan; and, parallel to it, as at *u*, equal to the breadth of the bevelling board, the line afore it will be for the purpose of laying down the bevellings of the timbers which come afore the joint, and that abaft for those which come abaft the joint; then, from where the joint of the cant timber intersects the middle line, in the half-breadth plan, square a line which shall intersect the lines struck on each side, and we shall find that the foremost intersection will come without the middle line of the half-breadth plan, and the after-one within it as at cant timber *u*, Plate I. Then, take the distance from where the horizontal ribband lines intersect the line struck at the foreside of the timber, square to the middle line in the half-breadth plan, and set them off square from the middle line in the body plan, where they shall happen to intersect their respective diagonals; level lines must be struck across the diagonals at every spot: because, owing to the great twist the same edge may cross the joint of its respective cant timber. Then take the distance where the horizontal lines intersect the fore edge of the same timber (but in the direction of the cant line) to where the squared line intersects the fore edge without the middle line in the half-breadth plan; and set off those distances square from the middle line in the body plan on their respective lines levelled out; a spot may then be introduced at the main-breadth in the same manner as was done in laying down the joint. To gain a spot at the heel, square up the intersection of the fore-edge with the bearding-line, or half-thickness of the deadwood, in the half-breadth plan, so as to intersect the bearding line in the sheer plan; then transfer that height to the middle line in the sheer plan, and level out a line; after which take the distance from the intersection of the square line in the half-breadth plan to where the fore edge cuts the bearding line, and set it off square from the middle line in the body plan, upon the line last levelled out, making a spot: next form a curve through the spots on the level lines at the heel and main-breadth, and the shape of the line will be described, which will give the bevellings for the foreside of the timber;

proceed in the same manner with the line abaft the joint, which will give the bevellings for the aftside of the timber; then, at the places where the edges come without the joint of the timber in the body plan, the bevelling is so much without a square or standing, and where they come within, so much within a square, or under in the breadth of the bevelling board, as in BODY PLAN, Cant *u*, *Plate I.*

Proceed, in the next place, to take the bevellings; to accomplish which, we will begin with the foreside of the timber; the heel bevelling must first be taken, which gives the direction to trim the heels of the futtocks the fore and aft way, which fays them to the deadwood; therefore, the outside of the deadwood being parallel to the middle line, we may apply the stock of a bevel well with the joint of cant timber *u*, in the half-breadth plan, and place the tongue well with the middle line, before the joint, which will be an under bevelling, and may thence be marked on the board; the bevelling of the heel may next be taken to firm it at the outside to the sheer of the bearding line, which must be done as follow: when the joint of cant timber *u* intersects the bearding line in the half-breadth plan, square it up to the bearding line in the sheer plan; and, at that place, raise a perpendicular; then fix the stock of a bevel to the said perpendicular and open the tongue forward till it lies in the direction of the bearding line, and this will be the bevelling, which may then be marked on the board.

To take the bevellings at the diagonals, fix one leg of a pair of compasses in the joint of the cant timber *u* in the body plan, when the level line intersects, and extend the other leg to the line representing the fore edge of the timber sweeping it till you get the nearest distance, and that will shew how much the bevelling is within or without a square in the breadth of the bevelling board (as at the upper diagonal, Plate I.) which may then be marked on the board; proceed the same with respect to the other diagonal lines, and the bevelling of each may be taken, and also marked on the board; the heel bevelling had better be obtained by trimming the outside of the timber parallel to the side cut off to fay against the deadwood to the thickness of the stepping.

To take the bevellings at the main and top breadth and horizontal lines, &c. between them, we shall only have to apply the stock of the bevel to the joint of the cant timber in the half-breadth plan, and place the tongue in the direction of their respective half-breadth lines; observing, to let the tongue teach forward; the bevellings for the foreside of the timber will be under bevellings, unless it be two or three of the lower ones, which on account of the cleanness of this part of the bottom will be standing bevellings.

The bevellings may then be taken for the aftside of the timber which will be standing bevellings, but the operation is performed the same as the former only observing, that the square line at the heel comes within side the middle line in the half-breadth plan, Plate I. and likewise where the bevel is applied to take the bevellings, its tongue must teach aft; these bevellings may then be marked on the other side of the board, and the board for that timber will be complete.

In like manner the bevellings may be taken for all the other cant timbers, both in the fore and after bodies, and may then be marked on their respective boards.

Before we dismiss this subject, we may remark, that those who would choose to lay off the bevelling edges by the horizontal water lines need only take the distances, from where (say) the fore edge, intersects each water line, to the square line at the heel in the half-breadth plan; and set them off from the middle line of the body plan on their respective water lines; and these spots will produce the curves that form the fore edge already run by the horizontal ribbands, and so may the other edges be likewise formed.

The cant diagonals or harpins are also canted for purposes similar to the cant timbers. When the moulds are made, square up the intersections of the cant timbers, from where they cut the respective horizontal ribbands, to the cant ribband, which gives their proper stations on the moulds; and a line taught from thence to cut the joint of the cant timber at the middle line gives the thwartship direction in which the cant timber stands, as at cant timber *s* in the fore body, and thirty-two in the after body; as may be clearly seen in the half-breadth plan of the cant bodies, Plate I.

ON THE UTILITY OF THE TRANSOMS, WITH THE MANNER OF LAYING THEM DOWN.

The transoms compose the stern frame, of which there are as many in general as the form of the body will admit of a kindly growth; the uppermost of them is called the wing transom, and by some the main transom: it is the foundation upon which the whole stern is built; (and therefore should always be of the best timber that could be procured.) The transoms below it are for the purpose of finishing the after part of the ship, termed the buttock, which must be allowed the strongest method that possibly can be; for all the transoms crossing the buttock, or aft part of the ship, and bolting through the stern post, may be esteemed equal to so many breast hooks athwart the bows; and when the planks are wrought on the buttock, and the wing transom knee bolted, it certainly may be admitted to be as strong as the bows, or fore part of the ship's body, which is supported by the breast-hooks.

Take from the draught the height of the transom, and describe them on the floor in the sheer plan, strike them also across the body plan, draw also in the half-breadth plan the round-aft of the wing transom, and margin lines taken from the draught, and likewise draw the round up in the body plan taken from the draught also; then the upper side of it being drawn in the sheer, set down below that what the round is, and draw another level line, upon which square up the touch of the wing transom from the half-breadth plan, and from thence draw a straight line to the intersection of the upper side with the fore part of the rabbet, which will represent the upper part of the aftside of the wing transom in the sheer plan; then in the body plan set off below the line for the upper side of the transom, the depth of the tuck rail, and describe another line parallel thereto, which is called the margin line, as from the upper side of the wing transom to this rail, is always trimmed by one bevelling right across, which bevelling is the rake of the rabbet of the post; the margin line must then be described in the sheer, by setting off the same depth there, and drawing another line parallel to the former, and likewise draw a line for the fore end of each parallel to the rabbet of the post. The margin line should next be described in the half-breadth plan; by squaring it down from the sheer plan, and drawing it parallel to the wing transom there, it will come as much within the line drawn for the wing transom in the half-breadth plan, as the bevelling of it in the sheer plan is within a square in the depth of the tuck rail.

The transoms may now be laid off from the buttock lines, but if they are laid down in the half-breadth plan, then only half or one side of them can be represented; the best method therefore will be to lay them down in some convenient place by themselves, whereby both sides of them may be represented, and there will not be then such a confusion in the lines.

Take from Plate II. the half-breadth plan, the middle line, main half-breadth line, wing transom line, buttock lines, cant line of each fashion piece, and as many of the square timbers as come abaft the heel of the fashion piece, and represent them in some clear place in the mould loft, in the same manner as the deck transom is disposed of in the half-breadth plan, Plate I. but describing them on both sides of the middle line; this, for distinction, may be termed, Plan of the Transoms: the shape of the wing transom is already described, to which the mould is to be made; the filling transom is next, which lies between the wing and the deck, and as it lies level, or parallel, to the upper edge of the keel, the description of it will suffice for all the other transoms that are under the deck, which also lie level; draw on each side of the middle line in the plan of the transoms, the half-thickness of the dead-wood or bearding line, taken from the half-breadth plan; then the distance in the sheer plan, from where the upper side of the filling transom intersects the foreside of the rabbet of the post, to any square timber, and set it off from the same square timber at the middle line in the plan of the transoms, squaring a line across to each bearding line, which line will represent the after part of the filling transom at the middle line; then, take the distances in the sheer plan from any square timber to where the filling transom line intersects the different buttock lines, and set them off from the same timber in the plan of the transoms, on their corresponding buttock lines on each side of the middle line; then take the distances from the middle line in the body plan, to where the line of the filling transom intersects the square timbers, and set them off on both sides of the middle line, on their corresponding timbers in the plan of the transoms; next, by letting a curve pass on each side of the middle line, from the aftside of the transom through the spots on the buttock lines and square timbers, the upperside of the filling transom, and so likewise with the others, will be represented.

There should also be spots set off in the plan of the transoms, to prove the intersection of the transoms with the side of the fashion piece, which is the end of the transoms; therefore the cant of the fashion piece must be laid down in the body plan, which is performed just in the same manner as the rest of the cant timbers; then take the distance from the middle line in the body plan, to where the different transoms intersect the cant of the fashion piece, and set them off from the middle line in the plan of the transoms, on the cant fashion piece there, which spots will give the exact ending of the transoms at the side of the fashion piece.

OF TAKING THE BEVELLINGS OF THE TRANSOMS.

THE bevellings of the transoms are generally taken from the buttock lines, in the following manner: apply the stock of a bevel to the line for the upper side of the transoms in the sheer plan, and the tongue to the buttock lines, letting the tongue be well at the upper and lower sides of the transom, which will give the exact bevellings of the transoms at their corresponding buttock lines; then, when the transom moulds are made to the lines in the plan of the transoms, the buttock lines must be marked on the moulds in the direction they are laid down, which is parallel to the middle line.

When the bevellings are taken in this manner they may be very exact, but it requires to be very particular in applying them on the transoms, for the stock of the bevel must be kept in the direction of the buttock line at the upper side, and the tongue must teach to the buttock line at the lower side, which should be marked there; then when this trouble is taken, the transoms may be trimmed to a nicety; but by this method the bevellings are confined to the buttock lines, by which means some of the lower transoms will not have above one or two bevellings upon them, which will not be sufficient to get the exact shape of the under side.

Therefore, the best method to find the bevellings will be to lay down the lower sides of all the transoms, in the plan of the transoms, which may be done in the same manner as the upper sides were laid down; then the distance from the upper to the lower sides in the plan of the transoms, will shew how much the transoms are under from a square in the depth, or siding of them, which must be the breadth of the bevelling board.

The lower sides being laid down, we may now have an opportunity of placing as many bevelling spots on the lower transom as we please, without any confinement, which may be divided equally between the breech and the fashion-piece; then fix one leg of a pair of compasses in each of the bevelling spots on the upper side, and sweep the other till it takes the nearest distance to the line for the lower side, which will shew how much the transom is under from a square at each bevelling spot, in the breadth of the bevelling board; in the same manner may the bevellings be taken for the rest of the transoms, except the wing and the deck, which is best taken from the buttock lines; the wing transom must be trimmed from the upper side to the margin line by one bevelling right across, which bevelling is taken from the upper side and the rabbet of the post, from thence to the lower side the bevellings must be taken from the buttock lines, as before described. Then the bevellings for the deck transom may be taken, by applying the stock of the bevel to the hang of the deck at the middle line, and the tongue to each of the buttock lines; keeping the tongue well at the upper and lower side of the transom; which may be applied on the transom, by placing the bevel at each corresponding buttock line, and keeping the stock out of winding with the upper side of the transom at the middle line.

The bevellings for the breech of the transoms must be taken from the upper sides of the transoms, and the bearding line in the sheer plan, and the ends of all the transoms when moulded are trimmed square from the upper side; but in applying the square to the ends of the wing and deck transoms, which round up, the stock of it must be lifted till it lies in an horizontal position, and should be looked out of winding with a batten at the middle line; then to find the bevelling for the ends of the transoms when cut off, apply the stock of a bevel to the upper sides of the transoms in the body plan, and the tongue to the line of the cant fashion piece, which will give the bevelling required; but to take the bevelling for the end of the wing transom, we must take the distance square from the middle line in the plan of the transoms, to where the end of the wing transom intersects the fashion piece, and set it off square from the middle line in the body plan, on the upper side of the wing transom, and level it out till it intersects the cant fashion piece, from which level line the bevelling may be taken to the cant fashion piece as before; the bevelling for the end of the deck transom may be taken from a level line in the same manner, but it must be observed in applying the bevel on the wing and deck transoms, to lift it up, as much as the transoms round down at the ends, and look it out of winding with a batten at the middle line.

TO LAY DOWN AND TAKE THE BEVELLINGS OF THE HAWSE-PIECES, BY THE WATER-LINES, IF HORIZONTAL.

These hawse-pieces, when in their places, are supposed to stand perpendicular, and their sides to look fore and aft, exactly similar to the square timbers, only their sides looking fore and aft instead of thwartships. Take the hawse-pieces from the General Dimensions, and strike them in the half-breadth plan on the floor, letting their lines end against the line of the foremost cant timber *s* as in Plate I. which will represent the heels of them; then the water lines being run in the half-breadth and sheer plans, they may be the level lines for laying off the hawse-pieces by, with the main and top-breadths, and likewise another level line too beween the main and top-breadths.

Where the foremost cant timber in the half-breadth plan crosses the water lines, main and top-breadth lines, and level lines between, square them up parallel to any square timber, to their corresponding lines in the sheer plan; also, where it crosses the bearding line in the half-breadth plan, square it up to the bearding line in the sheer plan, from which let a curve pass through all the spots set off on the water lines, &c. and the thwartship view of the foremost cant timber will be represented in the sheer plan.

Where the lines for the knight-head and hawse-pieces in the half-breadth plan cross the water lines, main and top-breadths, and level lines between, square them up to their corresponding lines in the sheer plan, which will give the spots through which the curves are to pass to represent the knight-head and hawse-pieces in their proper places, and where the lines for the knight-head and hawse-pieces meet at the foremost cant timber in the half-breadth plan, square them up to the thwartship view of the foremost cant timber in the sheer plan, which will give the heels of the knight-head and hawse-pieces in the sheer plan; and by drawing lines thence perpendicularly upwards, will be obtained the direction in which the heels are to be cut off to fay against the foremost cant timber; then by applying the stock of the bevel to the lines of the knight-head and hawse-pieces in the half-breadth plan, and the tongue to the line of the foremost cant timber, the bevellings to be applied to the heels to trim the thwartship way, to fay against the foremost cant timber, will be found.

The sides of the knight-head and hawse-pieces being parallel to each other, and they being supposed to fay close to each other when in their places, consequently, the line of one will serve to countermould the other, and from thence the bevellings of each may be taken; therefore, the bevelling may be taken at every sirmark, (that is at every harpin) which must be marked on the hawse-piece moulds, and in order to find their proper stations, take off the knight-head and hawse-pieces from the half-breadth plan, and represent them as so many straight lines, parallel to the middle line in the body plan; then where the knight-head and hawse-pieces in the body plan cross the diagonal lines, take off those heights and set off on their corresponding knight-head and hawse-pieces in the sheer plan; which will give the proper stations of the harpins on the knight-head and hawse-pieces; then fix one leg of a pair of compasses in the lines for the knight-head and hawse-pieces at the different sirmarks, and extend the other to the line of the next hawse-piece, sweeping it till you have the nearest distance, which will shew how much the bevelling is within a square in the breadth of the bevelling board, which should be in breadth equal to what its hawse-piece is sided. The bevellings at the heel to countermould them must next be taken, for which, take the heights in the sheer plan where the knight-head and hawse-pieces intersect the thwartship view of the foremost cant timber, and set them off on the line of the foremost cant timber in the body plan, at which spots erect perpendiculars; then place the stock of the bevel against the perpendiculars, and the tongue to the line of the cant timber, which will give the exact bevelling to be applied on the heel when cut off for the counter moulding of the knight-head and hawse-pieces.

If there was only this bevelling for the heel set off, and another at the head for the knight-head and hawse-pieces, the mould of their next hawse-piece, by being kept well at the head and heel, and likewise to its proper height, would consequently countermould them exactly.

OF THE

METHOD OF CONSTRUCTION CALLED WHOLE-MOULDING.

Having now explained the usual methods of forming the draughts, &c. we shall describe the method called *Whole-Moulding*.

Whole-Moulding is a method of constructing the body of a vessel so, that one mould, made to the midship-bend, with the addition of a floor-hollow, will mould all the timbers, below the main-breadth, in the square body *. Ships' Long-Boats are now the only vessels in which this method is practised; and of one of these the plan, with an elucidation of the subject, may be seen in Plate IV.

* See the article "Whole Moulded," page 141 of this work.

The art of whole-moulding depends entirely upon judiciously forming the rising line, with its half-breadth or narrowing, which must ever vary according to what the boat is designed for, whether for burthen or velocity; for, by whole-moulding no more is narrowed at the floor than at the main-breadth; nor must the rising line be elevated more than the height of breadth, that is, they must run parallel to each other.

The forming of the curve of the rising line requires some practice, so as to answer the end designed: for the draughtsman must comprehend, in his mind, both the form of the midship-bend and of the intended capacity of the boat; by which he may readily know how much to lift the rising line afore and abaft without lessening too much her internal capacity. See the rising line in the plan of the Long-Boat.

The depth of the boat is given in the table of dimensions, and the height of the main-breadth, at dead-flat, is a few inches below it, and continued thence, forward and aft, parallel to the rising line in the direction of the square timbers; which must be so far as the body is intended to be whole-moulded.

Enough has been already said, on drawing of the other lines, to render it unnecessary for us here to describe any others besides those which immediately relate to whole-moulding.

The form of the midship-bend is now to be considered; its main-breadth, being given in the table of dimensions, may be described by the segment of a circle, whose radius may be the distance between the rising line and height of breadth line, the centre being fixed in the latter line, as all above may be perpendicular; or, as the midship bend in the plan of the long-boat, Plate IV. Then, from the side of the keel to the back of the curve forming the upper part of the midship bend, may be drawn a straight line or a curved line, similar to that in the plate.

We may now proceed to form the other timbers in the body plan thus: take the height of the rising line at each timber, in the sheer plan, afore dead flat, and set off those heights and above, parallel to the base line, or upper edge of the rabbet in the fore body: the same must likewise be done by the height of breadth-line. Then take off the several half-breadths corresponding to each, from the half-breadth plan, and set them off on their respective heights from the middle line in the body plan. Now, let a mould be made to the form of the midship bend, from the rising line to the topside and a few inches above, faying also along the rising line: then let the lower part, which is straight, be laid upon the several rising lines, with the upper part just to touch the spot for the half-breadth on the half-breadth line, corresponding to that rising line upon which the mould is placed. A curve may then be drawn by the side of the mould to the rising line. In this manner we may proceed so far as the rising line is parallel to the height of breadth line. Then, a hollow mould must be made to the curve that completes the lower part of the midship bend, letting it run some length beyond each way, as that marked Floor Hollow in the plate. This is applied in such a manner, that some part of the hollow may touch the side of the keel and back of the curve before described by the bend mould, beginning forward. The floor-hollow will always come lower on every timber, till we come to the midship timber first designed.

Having thus formed the timbers, as far as the whole-moulding will serve, (for the after body is formed exactly in the manner just described,) the timbers close forward and aft are next formed. Their half-breadth are determined by the sheer and half-breadth plans, and are the only fixed points through which the curves of these timbers must pass. Some form these after timbers before the whole is moulded, and then make the hollow mould, which will be more straight than the hollow of either of these timbers. It is indifferent which is first formed, or what methods used; for, after the timbers are all formed, though every one may appear very fair when considered by itself, it is yet uncertain what the form of the side will be. In order then to determine this, run several ribband or water-lines; and, if these do not make fair curves, they must be rectified, and the timbers from them. From these, also, the form of the transom may be described, letting the lower end of it be clear of the load water-line, that the boat may have no dead water to draw after her.

This method of whole-moulding will not answer for the long timbers afore and abaft. Consequently these are generally canted in the same manner as those of a ship.

In order to render this explanation the more complete, we shall here describe the manner of moulding the timbers, after they are laid down in the mould-loft, by the bend mould, rising square, and hollow mould.

The same method is used on the loft floor as was used in constructing the draught; the only difference in this case is, that it is laid off to its full size, and the moulds made to the proper scantling. Now, when the moulds are set, as before directed for moulding or shaping each timber, let the middle line, in the body-plan, be drawn across the mould, and draw a line across the hollow mould at the point where it touches the side of the keel. Next, let them be marked with the name of each timber as shewn in the plate. The graduations on the mould will therefore be exactly the same as the narrowing of the breadth. Thus, the distance between $\overline{\oplus}$ and F on the mould is equal to the difference between the half-breadth of the timber F and that of $\oplus$.

The height of the head of each timber is likewise marked on the mould, and also the floor and breadth sirmarks. The floor sirmarks may be that point where a straight-edged batten touches the back of the mould, the batten being so placed as to touch the lower edge of the keel at the same time. The several risings of the floor and heights of the cutting down line are marked on the rising square, and the half-breadth of the keel set off from the side of it.

The moulds being thus prepared, as represented in the plate, we shall apply them to mould floor timber F.—The two moulds being made alike, and crossed on the reversed side, lay one upon the other as there shewn.

Having first sawed the timber to its siding (commonly called a flitch) keep their lower edges in a straight line, and move them until each corresponding middle line on the moulds agree; and, likewise, so that they may best answer the round according to the grain of the wood.

The moulds in the plate are fixed at timber F; but, as the middle line on the lower mould cannot be seen, it is best to mark the middle lines also upon the edges.

When the moulds are placed, fix the inside edge of the rising-square, to the middle line on the mould of the timber, and the other edge of the square will represent the side of the keel, which may now be rased upon the piece. Then move the square till the side of it comes to F on the mould: then a line being rased by the side of it, will represent the middle of the keel. The other side of the keel must be rased after the same manner, and the point F, crossed on the rising square, be marked on each side of the keel, and a line rased across at these points to represent the upper edge of the keel. From this line the height of the cutting down line at F must be set up and squared across, and then the rising square may be taken away, and the timber may be rased by the side of the mould, both inside and outside, from the head to the floor sirmark; or it may be rased lower if necessary.

After the sirmarks and heads of the timbers are marked, the floor moulds may be taken away, and then the hollow mould applied to the back of the sweep in such a manner that the point F upon it may intersect the upperside of the keel, before set off from the rising square; and, when in this position, the timber may be rased by it, which will complete the outside of the timber. The inside of the timbers may likewise be formed by the hollow mould. The scantling at the keel is given by the cutting down before set off. The mould must be so placed as to touch the sweep of the inside of the timber formed before by the floor mould, and pass through the cutting down point.

In the same manner mould the other arm of the floor, by canting the square. But the rising and cutting down must be marked on both sides.

But, as we intend that only one rising square shall be used, the fore body is rased on one side, and the after body on the other. It is here necessary to observe that, when the square is wanted on the opposite side, it is requisite to chalk, on the edge of the square, the rising and the cutting down for the timber you are going to mould; and then to cant the square.

The mould for moulding the futtocks is made similar to the floor moulds: only it extends upwards to the top of the sheer. The same method of fixing the rising square for the moulding of the floors will serve to mould the futtocks, as may be readily seen in the plate. When the inside of the square appears fixed to the middle line on the futtock mould for 8; then the hollow mould, applied to the back of the futtock mould, in such a manner that the point 8, upon it, may intersect the rising of 8 on the square, gives the moulding of the outside of the futtock.

The inside may be moulded in the same manner as the floors. Before the moulds are moved, mark the main-breadth, head, and sirmarks, or floor-head, in the same manner as the floors, in order to place the futtock to its proper height at the side of the floors, in case they should not be required to run down to the side of the keel.

You may make two futtock moulds, or cross the fore body on one side of the mould and the after body on the other; then, in order to mould a futtock for that side where the sirmarks are on the under side, chalk over the sirmarks for the required futtock on the edge of the mould; or, make two margins on the edge of the mould, reserving one for the fore body and the other for the after body, and reverse them on the opposite side.

If the futtocks of the long-boat are only to run down half-way between the floor-head and side of the keel, the heels should be marked on the futtock mould though moulded by the square; for then the edge of the square may be put to the proper mark on the mould for the heels of the timbers.

The use of the sirmarks is, to find the true places of the futtocks; for, as they are cut off short of the keel, they must be so placed that the futtock and the floor sirmarks may be compared and coincide. Notwithstanding which, if the timbers are not very carefully trimmed, the head of the futtock may be either within or without its proper half-breadth; to prevent which, make use of a half-breadth staff.

The half-breadth staff may be about three quarters of an inch square, and of a convenient length. Upon one side of it are to be set off, from one end, the several half-breadths of all the timbers in the after body; and those of the fore body on the opposite side. On the other two sides are set off the several heights of the sheer, the after body on one side, and the fore body on its opposite. Two sides of the staff are to be marked *half-breadths*, and the other two sides, *heights of the sheer*.

The staff being thus prepared, and the floor timbers fastened on the keel and levelled across, the futtocks must next be fastened to the floor timbers; but they must be set first to their proper half-breadth and height.

The half-breadth staff, with the assistance of the ram-line, serves to set them to the half-breadth: for, as the keel of a boat is generally parallel with the horizon, therefore the line at which the plummet is suspended, and which is moveable on the ram-line, will be perpendicular to the keel. Whence we may set the timbers perpendicular to the keel, and then set them to their proper half-breadths by the staff. When the two sirmarks coincide, the futtock will be at its proper height, and may be nailed to the floor timbers, and also to the breadth ribband, which may be set to the height of the sheer by a level laid across, taking the height of the sheer by the staff from the upper side of the keel. By these means we shall discover if the ribband be exactly at the height of the sheer; and, if not, the true heights may be set off by a pair of compasses from the level, and marked on the timbers.

PRACTICAL DIRECTIONS FOR THE ACTUAL BUILDING, PROGRESSIVELY ARRANGED.

A SLIP being provided, the blocks are laid at the distance of about five feet asunder, to receive the keel, from which the structure is to be raised. Each block is laid upon a ground-way in the middle of the slip, unless a small vessel is intended to be built where the launch has been laid for a large ship. In this case, by keeping the blocks towards one side, the sliding planks may be made to answer for that side. The blocks, being the foundation of the whole, must be very carefully fixed. The lower tier should be large, as a base; and fayed upon the groundways, that they may be steady, with the corners nailed down. Upon the lower tier of blocks is fayed another tier; and the upper tier is composed of such as are sawed about sixteen inches broad, from two to three feet long, and the upper corners taken off with a snape endways. These blocks are fastened to the lower blocks, with a treenail in each end, and upon them are fayed caps of oak, as broad as the upper tier of blocks, and as deep or deeper than the false keel is thick. The caps are treenailed down to the upper blocks without the sides of the keel; and they should be clear grained, that they may split out the easier when the false keel is put under.

The height of the blocks and their declivity must be seriously considered. These particulars depend wholly upon the magnitude of the ship and depth of water it has to launch into. Be particularly careful that the fore-foot is kept clear of the after groundways in launching, allowing for the settling of the ship.

The declivity of blocks to build upon is generally from three-fourths of an inch to one inch in a foot. The upper sides of them are made straight fore and aft, and level athwartships; sometimes the after blocks are raised above a straight, as the great weight of the stern and overhanging generally settles in building.

KEEL. The keel is generally of elm, sawed full to the dimensions given in the Tables; but, in sawing the scarphs be careful to allow thickness enough at the lips in addition to those in the Tables, that there may be substance sufficient in the scarphs to raise the coaks, which are from one inch to one inch and a quarter thick. The workmen trim the several pieces that the keel is composed of, straight and square. The scarphs have a coak raised towards the lip, and a coak sunk from half the length of the scarph. The breadth of the coaks is one-third of the depth of the keel and placed in the middle. The several pieces are fitted together and made to fay neatly in the scarphs; then taken asunder and lined one quarter of an inch on the lower edge of one of the scarphs, and wear off at three or four inches upwards for caulking.

The rabbet for receiving the bottom plank may be trimmed out, leaving about two feet from the ends of the scarphs for reconciling. The rabbet is lined down from the upperside of the keel to the thickness of the bottom plank, in the navy; but, in most merchant ships, the rabbet is taken out in the middle of the keel to prevent its canting. The rabbet is sunk in by moulds made to the shape of the body from the mould loft.

The keel is now placed on the blocks, and tarred flannel laid between the scarphs. The scarphs are next bolted; with the upper bolts kept just below the rabbet and the lower bolts about four inches up from the lower edge for caulking. The keel is then canted for caulking the scarphs. After it is canted back, it is set fair and straight along the middle of the blocks; and, to keep it in that position, treenails are driven in. The blocks along the sides of the upperside of the scarphs are then caulked, and an oak batten, three-quarters of an inch thick, is let in over the joint of the scarph with tarred flannel under it.

DEAD OR RISING WOOD. The Dead or Rising Wood is of oak timber, of various thicknesses, trimmed and fayed upon the upperside of the keel. The pieces along the midships are of the thickness given in the Table of Dimensions, and, in breadth, to overhang the keel about two inches on each side. The scarphs give shift to the scarphs of the keel, and fasten thereto with treenails. The deadwood afore and abaft, for the security of the half timbers, is to be tabled together, and to be of such height as to answer with the underside of the keelson and give shift to the scarphs of the main keel and to each other. This part of the dead-wood below the stepping is trimmed to the shape of the body by moulds.

The deadwood above the stepping or bearding line is trimmed to a perpendicular and to a parallel thickness.

STEM. The stem is composed of two or more pieces of oak timber, of the best quality, as shifting it is very expensive. It is first sawed and then trimmed to its siding given in the Table of Dimensions, out of winding, and then moulded square from the siding to the stem mould. The several pieces are scarphed together with a hook-coak as the keel; the scarph at the lower end is trimmed out to the boxing; the other scarphs the flat-way. The rabbet is next trimmed out, leaving wood in the way of the scarphs to reconcile.

On the stem should be marked, from the mould, the heights of the harpins, decks, cheeks, &c. and a line square from the keel as a guide to set it by.

APRON. The Apron is first sawed and then trimmed straight and out of winding to the siding given in the Table of Dimensions. It is fayed to the inside or aftside of the stem, to succour it in the scarphs; then moulded square to the size given in the Table of Dimensions. The scarphs of the stem are then bolted through the stem and apron, and clenched thereon. Tarred flannel being previously laid in the scarphs, observe to place the bolts within the rabbet.

BOLLARD TIMBERS. The bollard timbers are sawed, then trimmed and fayed to the side of the stem, or apron, with the aftside straight to fay to the hawse-pieces: then moulded and trimmed to the bevellings. They are connected by coaks or tablings to the stem or apron, and bolted wholly through, wherever practicable.

HAWSE-PIECES. The hawse-pieces are sawed, then trimmed straight to the sidings, as in the Table of Dimensions, to fay to the bollard timbers, and to each other, in wake of the hawse-holes; then moulded and trimmed to the bevellings, and separated above and below the hawse-holes for the admission of air, to about one inch and a half. When in their places, they are to be bolted to the bollard timbers and each other, clear of the breast-hooks and hawse-holes. Let it be observed that the hawse-pieces should be so disposed as to be equally cut by the hawse-holes.

STERN POST. The stern-post should be provided for the top end to work upwards, if to be gotten, and sawed full to the given dimensions.

To trim it, let the aftside lay upwards, and get a middle line thereon: set off from this middle line, equally, the siding of the post given in the dimensions, and trim it straight through and out of winding. After it is canted, the mould will describe the size, the fore and aft way, and likewise the rabbet, the length at the head and heel, and the stations of the transoms and harpins.

Cut off the heel, allowing for the length of the tenons, which is one-third of the depth of the keel, and their thickness, or athwartships, one third of the keel; the thickness at that place and breadth, or fore and aft, twice their thickness; from the latter size to taper three-eighths of an inch each way in the length.

The rabbet is next trimmed out, at the upper end, to an equiangular triangle, to the thickness of the bottom plank; and, at the lower end, or heel, to about a half inch standing bevelling from the aftside of the rabbet. The foreside of the post may then be moulded to the bearding, or shape of the body, on each side of the middle line, and trimmed thence to the depth of the rabbet. The fore and aft tapering of the post may be then trimmed to what the keel tapers in the breadth of the post, at the heel, wearing off at the tapering up the back. When the post is trimmed, drive an iron hook over the head to prevent its flying.

INNER POST. The inner post is sawed to the given dimensions, then trimmed to its taper, and fayed upon the foreside of the main post; the head to let up one inch into the underside of the transom next above it. It is fastened to the main post with treenails, and a tenon is made at the heel as on the main post.

TRANSOMS. The transoms are sawed to the sidings as in the Table of Dimensions, whether rounding upwards or straight; and to their shape to the moulds. The wing-transom, if sawed only to the margin bevelling, may be brought in for other uses if found defective; for transoms require much trouble and expence to shift them, and the quality of the timber ought, therefore, to be of the best, and quite free from any defect whatever. In converting the transoms, let care be taken to work them top and butt.

The transoms are to be trimmed with the greatest exactness, and then let on the post, with scores on each side, of an inch deep or more, observing great precision as to letting them down, horning, and position. The ends, when cut, are left long enough to tenon, and face on to the fashion-pieces one inch and a half.

The ends of the filling-transoms may be cut with mouths for air, in the same manner as beams.

FRAME TIMBERS. It is of the greatest consequence to the formation of the ship, that all the frame timbers should be sawed square, but, more particularly, trimmed very correctly to the moulding and bevellings. They are mostly sided straight, and out of winding, except where any particular timber requires a cast, to make a port, &c. But, with filling timbers, the grain of the wood had better be followed in the siding than be grain cut, to make it straight, if the piece should not have grown so. The bevellings or windings, as they are applied, should be with great care kept out of winding from one spot near the middle of the piece.

The frame timbers should be converted of sound well-grown wood, without sap or vein appearing in wake of the ports, and full to their sidings, so that their scantling may remain after the port is trimmed out. Every timber should also be provided to its length; consequently, each should stand upon its proper head. Or, if one timber happens to be short, provide the next long enough to make good the deficient length, as *through-chocks* should always be rejected, or only admitted on extraordinary occasions. The heads and heels of all the timbers to have one third of the substance left the moulding way when trimmed, and the seats of the chocks should not exceed once and a half the siding of the timber.

In providing floors, care should be taken to reverse the butt end of each succeeding floor; because the tops may sometimes be scanty; and, when short of the floor-head, may be admitted, if the second futtock runs down and meets upon its respective floor.

Where timbers wind or twist much, as the fashion-pieces, &c. they should be counter moulded; especially when the sawyers may be depended upon.

FLOORS, Floors, excepting cant-floors, are generally sided straight to the given dimensions, and then moulded as follows. Say, for example, one of the midship floors, which are represented by ⊕ (1) (2), &c. as in the sheer-draught, Plate I. Take the two floor moulds and lay them on the timber, placing the end of the one over the end of the other, and moving them till the middle line of each is exactly well with the other, and the under part of both forms one straight line. They may be then confined together in that position, either by a nail or gimlet, just to hold them together for the present. Next set off, from the middle line on the moulds, the half siding of the keel, at which place apply the rising square, keeping the arm which is not marked well with the lower parts of the moulds; then to the side of the rising square apply the cutting down batten, keeping the lower end of it well with the line marked ⊕ on the arm of the square. We shall now see whether the piece will make the floor by moving the moulds downwards (taking the greatest care not to alter their position) till the line marked dead-flat, on the cutting down batten, is well with the upper part of the piece; then, if there be wood sufficient at the outside of the moulds at both ends, and likewise whole wood below the cutting down, according to the dimensions, the moulds may be rased by on the timber. Then, by taking the floor-hollow, and keeping that line on the lower end, marked for the side of the keel, well with dead-flat on the rising square, and the other end well with the floor mould, the true shape of the floor will be described from the head to the side of the keel; and we shall thereby see the size and shape of the chocks, which will be required to make the undersides of the floor next to the keel.

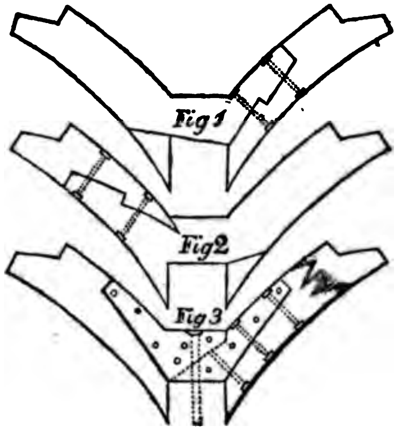
The operations of moulding the floors by this method are all alike, and performed just in the same manner as those of dead-flat; only observing to leave sufficient wood in the throats of those floors which have bevellings where the cutting down rises.

When a frame of battens is made to take all the floors of the square body, or nearly so, the floor is moulded by boring holes, with a small gimlet, at the sirmarks and head; and the floor is moulded by its corresponding first futtock mould being applied to the holes, as bored.

The cutting down is marked in the same manner from the mould, and the scantlings are next set off square from the sirmarks. The inside of the floor is moulded by a thin batten tacked thereto, and thus will the moulding shape of any floor be obtained.

After the floors are sawed, as above described, they are to be very correctly trimmed by the shipwright; for the truth and precision of the whole fabric may be said to depend upon the accuracy of the floors when got into the ribband.

In trimming the floors, let the chocks be first fayed that make good the deficiency of the underside next the keel. Then trim the joint-side straight and out of winding, as before observed. The joint's side in the fore body, is the aftside of the floor, and in the after body, the foreside. The floor is now to be sided parallel to the joint-side, to its siding dimensions; then moulded and trimmed, very correctly, to the bevellings as before described. From the joint-side, the inside of the floor is next trimmed to its cutting down and scantling: scores may then be taken out, on the underside, to seat them on the dead-wood, observing, to keep the given substance below the cutting down; *and, that the cutting down be not raised to gain that substance.* In merchant ships the floors have scores cut on the underside, about one foot out from each side of the keel, to let the water come freely to the pumps.



The RISING FLOORS, particularly those close aft, are, from the acute angle they form, very difficult to be gotten; and, as a substitute, many have been induced to make them of three or more pieces called *made floors*, and those are most to be preferred that are made the strongest from straight timber. Let Fig. 1. in the margin, represent one near aft, with a short arm on the larboard side, and the deficiency made good by a piece scarphed on and bolted. The respective first futtock is to be bolted fore and aft to both parts.

Fig. 2. is similar, but more out-square, consequently easier to be obtained.

Fig. 3. is composed of two straight pieces, scarphed together in the middle, with a lap scarph. Upon the foreside of the lap scarph is fayed and bolted a chock, extending equally from the middle line; and, in depth, from the cutting down to the upperside of the score; sided the same as the lower futtock, whose heel fays with a corresponding scarph to the chock, and is bolted as shewn in the figure. This may be deemed sufficiently strong for this part of the ship.

The floors, when trimmed, are crossed in their respective situations, in scores cut in the deadwood, to the exact height of the cutting down, set correctly level, and horned, or squared, from the middle line. In the Royal Navy and most Merchant Ships, the floors are bolted through the keelson and keel. It may, therefore, be necessary to drive a small bolt in some of the floors, that they may not rise when ribbanding. Be careful to place this temporary fastening clear of the keelson bolt, which is in the middle of the floor: or, which is better, drive a temporary eyebolt, hand-taught, through the hole in the middle of the floor, and forelock it under the keel; as this hole may hereafter be bored upwards with a *joint-auger* through the keelson. The floors may then be ribbanded and shored. The shores to be capped, nailed at the head, and nogged at the heel.

FUTTOCKS. *Lower futtocks, second or middle futtocks, third futtocks, fourth futtocks,* and *top timbers,* are first sawed and then trimmed to the given dimensions, similar to the floors. In the Royal Navy, the heels of the lower futtocks run down to the deadwood; but, in Merchant Ships, they are from nine to twelve inches short of the side of the keel, that water may not lie above the ceiling. The wood wanting on the inside of the lower futtocks, in the navy, is made good by chocks, fayed across, up to the cutting down.

The timbers that compose a frame, or bend, are bolted together, either close or opened, as required; the joint side of the second futtock to the joint side of the first or lower futtock, agreeably to the shift or scarph, as given in the dimensions. The heel of the third futtock joins the head of the first or lower futtock, and bolts to the second with bolts of the number and size given in the Table of Dimensions. The iron being square, the heel of the fourth futtock joins the head of the second, and bolts to the third; and the heel of the toptimber scarphs on the head of the third futtock, and is bolted or fastened with treenails to the fourth futtock; taking care that no bolts be driven in wake of the ports or port-sills. (*See Midship Sections, Plate III.*)

The frames, when bolted together, have chocks fayed in the seats at the heads and heels, and fastened with treenails: and, to prevent their straining, when hoisting, quartering is sometimes nailed over the joints of the chocks and timbers, and a shore, fitted on the inside, or bag of the frame, and stopt at the head and heel with cleats. A chain is then set taught round the back of the frame. This should be carefully attended to; for, if the frame be strained in hoisting, its form becomes altered, and the true shape of the body lost.

The frames are raised into their places by tackles, which are lashed to sheers, or travel upon a *ridge-rope.* One tackle is applied to the heel of the frame to lighten it off the ribband, and one or two near the main breadth, and another to the heel, to prevent its going too far into the ship. Some cant the frame, and heave up the heel by one of the breadth tackles, landing it on the ribband; and, then, to prevent it from going too far into the ship, they bore a hole, and thrust in an eyebolt, which stops it against the ribband.

The frames as hoisted are shored and cross-spaled, either in the ports or at the main-breadth. Upon the cross-spales is marked the middle line and the breadth of the ship at the place of spaling, to which the outside of the frame must exactly conform, before the cross-spale is nailed. In the turn of the body, as the cross-spales cannot be nailed in the joint, the breadth must be squared in. Observe that, when the frames are cross-spaled in the ports, they need not be cut at the ends, but may remain till the ship is planked, and the beams in and knee'd. The only objection to spaling in the ports is, that it is thought by some to be too high.

The frames may now be ribbanded thus: the cant-frames may be gotten near to their stations by the harpin moulds, then the harpins gotten up; and, if the frames come fair, may be nailed and shored to their sirmarks, seeing that the frames are exactly levelled; or, in other words, that, by a plumb suspended from the middle line on the cross spale, each is found to agree with the middle line on the keel or floors.

The square frames being levelled, as just described, and the floor sirmark or guide exactly corresponding, set them square from the middle line and keel as follow: stretch a line athwart, at the main-breadth, or at any distance parallel below it; then look this line and the joint of the frame out of winding, to the edge of a batten (by some called a rake and level) fixed in the middle line. The batten tapers in its length, from a straight edge, equal to the set of the ship in every foot; so that, when the raking edge is kept aft and set plumb, the straight edge should correspond with the line at the breadth and joint of as many square frames as you may please to set, which may be every fourth.

The spacing of the ports may likewise be proved by a long staff, upon which their stations are to be marked, as taken from the floor or mould-loft. The ribbands may be then nailed and shored; and, to prevent their altering afterwards, let them be nogged at the heels and cleated.

The lower futtocks are now to be bolted to the floors similar to the shift or scarph above: and, in large ships, along the uppersides of the lower cross-spales, are to be nailed two rows of deals, about nine inches on each side from the middle line, and a ribband nailed down near each midship edge. To the ribband the topside is shored, and kept steady at each frame by being cleated over the heads, in the range of the top-timber line; each lower cross-spale being shored underneath upon the keelson.

HARPINS. The harpins are sawed to the moulds and bevellings; then trimmed, and scarphed together with a key-scarph, because of their curvature. They consist of two or more pieces, and the scarphs are lined over, with oak or elm board, to strengthen them.

KEELSON. The keelson is sawed, and then trimmed to the given dimensions, thus, the sides are trimmed straight and out of winding, and upperside square from the sides; the underside is fayed close upon the floors and cross-chocks; but, previous to this, the openings between the floors and cross-chocks are filled in with pieces of dry oak driven down tight, with the grain athwartships, to the siding of the keelson and close down to the dead-wood. Then, between each floor, scores are taken out, as low as the keelson is to be let down, according to the Table of Dimensions, and likewise to its siding. The different pieces of keelson may then be fayed, either by a given mark or by counter-moulding. By the former, shipwrights sometimes get each piece of keelson into its place, as it comes from the sawyer, and with compasses square up the butts of all the scores on each side; then, by taking with the compasses the greatest distance, let that be a parallel mark to be pricked upon the piece from the surface of the floors, also the scores at every butt. Lines may then be struck to every spot, which, when trimmed straight through the piece, will consequently fay into the place designed.

To fay a piece of keelson by counter-moulding, proceed thus: Fay a piece of deal board, on one side, into all the scores and upperside of each floor and scarph, the whole length of the piece; then square over from the side of the mould three spots, one near each end and one in the middle, making sirmarks on the mould at each place: next take the windings or bevellings at each spot, keeping them out of winding with the middle one, and marking them on a board, or at its respective place on the mould. Then fix the mould on the same side of the piece of keelson, it was made to, observing that, when fixing the mould, the depth of the keelson is preserved as given in the dimensions. Now rase upon the piece the faying edge of the mould, and the square spots for the windings; but, if there are veins on the edge, let the mould be tacked on and dubbed straight through to the mould.

Next trim through the winding spots, as they were taken, squaring them over to the other side; or prick off the windings with the compasses: then, to counter-mould the other side, fay the mould as before; but, to the opposite side, marking the square spots very correctly on the mould when fayed. Then fix on the re-fayed mould to its respective side of the keelson, keeping the fayed edge well with the winding spots; the square spots at the same time, exactly agreeing. The underside of the keelson may now be trimmed straight through to the mould, and, when in its respective situation, if carefully done, it is sure to fay at once. Observe, previous to the keelson's going into its place, that all the joints or seams under it are caulked and paid, and the whole surface paid with tar.

Thus, by counter-moulding, or taking a mark, are to be fayed all the various pieces in the ship.

The scarphs of the keelson are trimmed with a hook-butt in the middle of their length; the length of the scarphs and the substance at the lips are to correspond with the given dimensions, and the middle of each scarph is to be so disposed as to come in the middle of a floor.

In the Navy, the keelson is bolted through every floor, and the bolts clench on the underside of the main keel. In East-India ships it is bolted through the six-inch keel also. Some ships have their keelson bolted through every other floor only. The bolts must be driven clear of the joint in the keel scarphs, and the bolts through the after dead-wood must be so disposed, on the underside, that one may come about nine inches from the after end of the keel, and the next bolt abaft it through the heel of the stern-post, to secure the extremities. Every bolt should be clenched upon plates or rings, of a full size, let up within the wood, and the points all caulked after the said ring or plate is let up. The keelson and dead-wood bolts abaft, when very long, are driven with two drifts, or sizes, from the middle of the length, for more readily driving the same, and the greater certainty of getting them through when so driven. The lower end of the bolt is to agree with the size given in the Table of Dimensions, and the upper drift one-eighth of an inch larger.

Many objections were formerly raised against double-drifted bolts, as, in repairs, they could not be driven out downwards. The strength of the ship, however, depends very much upon these bolts coming through; and double-drifted bolts, particularly copper bolts, are indispensable. The newly-invented machines for drawing bolts*, have, in great mea-

* This subject is fully described in "The Elements and Practice of Naval Architecture," 4to, and illustrated with an elegant plate.

sure, removed these objections; and, if a three-inch plank be wrought upon the upperside of the keelson, before the bolts are driven, this plank might be cut away upon a repair, or occasionally, when any bolt is required to be drawn out, so that the chops of the machine may take hold of the bolt. The keelson might otherwise be much wounded, and probably spoiled. Besides, this plank would have the chases of all the pillars on it, which would otherwise tend very much to injure and rot the keelson.

STEMSON. The stemson is sawed to the given dimensions; then trimmed and fayed to the apron, similar to the keelson, and scarphs with a hook and butt into the fore-part of the keelson. The bolts through the *breast-hooks* must be considered, and one or two bolts may then be driven through between them.

STERNSON KNEE. The sternson knee is sawed to its moulding and siding as in the Table of Dimensions; then trimmed and fayed against the transoms and upperside of the dead-wood, and scarphs with hook and butt into the after-piece of the keelson. It is bolted through the posts and transoms as the keelson, of which it is a continuation.

COUNTER RAILS. After they are sawn or trimmed to their round-aft, may be trimmed to their round-up by a straight batten tacked at each end as much below a straight or horizontal line as the rail is intended to round-up in the middle: the ends of the battens to be elevated and kept out-of-winding equal thereto. Then a line, stretched straight across the battens and against the round-aft, will give the true round-up, or curve to trim the the upperside to, and the underside may be trimmed parallel thereto. This may be exemplified by taking a wine glass and half filling it with wine, or any dark liquid; then cant or incline the glass a few degrees, the liquor keeping its horizontal position will represent the upper edges of the battens, while the liquor against the sides of the glass will represent a true round-aft, and likewise the round-up.

WALES and PLANKING. In general, after the strakes are lined out upon the ship's side, and the butts shifted *(See Planking, Plate III.)* some spile for each plank with a flat batten called a rule-staff, which is tacked to the ship's side where the plank is intended to be worked. Then, upon the staff, the length of the plank is marked, and as many spilings taken as may be thought necessary, or at about three feet distance, to the line the plank is intended to be worked to; or, when plank is wrought to the edge of the plank designed to work to, a touch, or any sudden angle, must also be marked upon the staff; and, at about every three feet distance, a bevelling spot is to be numerically marked thus (1), (2), &c. as at those places the bevellings are taken and marked on a small board. The several breadths of the plank are likewise to be marked down at those spots. To apply this staff, when the inside of the plank is spiled to the spilings, breadths, &c. must be canted or shifted to the other side of the staff, preserving the spilings on their proper edge. This is evident, or else the staff cannot be applied as taken. Some, when the plank is wrought, spile to the outside edge, keeping the staff off parallel to the thickness of the plank; then the outside of the plank may be certainly lined, and the spilings applied as taken.

The workman, by applying this staff, has every opportunity of seeing if the plank will line to its spilings and breadths clear of sap, also to its length; then, if the plank will line, observe, however unfair the spiling edge may be, always to line the opposite edge fair. Workmen who have been used to the lining of planks will line a number of them without spiling, by examining the edges which the plank is to work to.

The after lower piece of wale generally comes upon the end of the wing-transom, or sudden turn of the body; it consequently twists very much, and should be of a short length. This piece, and some below it, besides what spilings can be obtained, is generally trimmed by moulds made to its upper and lower edges. The upper edge is trimmed, or sawed, square to the timbers; the lower edge to a level, and then trimmed back, between two squares, to the thickness of the next plank under it, winding all the length from one given spot. When wrought, the outer edge is levelled in to the line on the side.

INBOARD THICKSTUFF CLAMPS, &c. These are wrought similar to the outside stuff. The clamps to the sheer of the deck, and their uppersides to the round-up of the beam, and the lower edge square from the timbers; unless they work down to the ports, then in wake of the ports. The lower sides are trimmed level, and between the ports square to the timbers, to the thickness of the stuff underneath. Clamps over ports are mostly bearded from half their depth to one inch less in thickness on the underside, excepting in the middle. Over each port is left a semicircle, for the muzzle of the gun to house to.

The Thickstuff is to be wrought with a square close edge, over the joints of the timbers, and the spirkittings are to have a seam allowed agreeably to the thickness with the outside stuff; that is, to every seam and butt of two inches thickness, a seam of one-eighth of an inch; to every one of two inches and a half thickness, three-sixteenths; of three inches, one quarter; of four inches, five-sixteenths; of five inches, three-eighths; of six inches, seven-sixteenths; of seven inches, one half-inch; of eight inches, nine-sixteenths; of nine inches, five-eighths; and of ten inches, to have a seam of three-quarters of an inch.

BEAMS. Beams, whether whole or in pieces, are sawed to their scantlings, the siding way, as given in the Table of Dimensions: on the ends or butts next the side to which the lodging-knee fays, tails are left, of as much as the piece will convert; this makes the lodging-knee more out-square; consequently, the easier to be gotten. Tails converted likewise on the foreside of the two foremost beams, assist the hanging knee, as it reduces the bevelling in that sudden turn of the body. The moulding is also sawn to the size given in the Table of Dimensions, to a mould make to a segment or arch of a circle, the chord of which is to be equal to the length of the midship beam at least, and the versed sine equal to the round-up of the deck. This mould so made, is called the *round-up of the deck-mould.* One side of the piece is rased by this mould; two spots are then to be squared over out of winding to the other side, and then *counter-moulded;* and the scarphs lined out, if the beam consists of two or more pieces. If this can be taken, and the sawyers cut true, the beam may be tabled together, and requires no trimming afterwards by the shipwright. Beams in one piece ought to be converted so to trace their butts the reverse way, as they follow each other, the butt being most subject to decay first. Beams of two or more pieces, when well put together, are allowed to be equally strong, if not stronger, than beams in one piece.

Beams made of two pieces and sawn with a scarph, one-third in length of the beam, taperwise, allowing for the thickness of the tablings, besides the thickness of the lips given in the Table of Dimensions.

A beam made of three pieces has the middle piece cut anchor-stock, to half the length of the beam. The end pieces each half the length and the scarphs of each lined taperwise, allowing the thickness of the tablings and lips.

A beam made of four pieces has two middle pieces lined anchor-stock, each two-sevenths of the length of the beam; and end pieces, likewise of the same length, the scarphs lined as before directed.

In putting beams together, much nicety in the workmanship is required. We have before supposed them to be correctly sawn; for, if not, the sides must be trimmed straight and *out-of-winding;* likewise the side of the scarph; then the moulding way must be trimmed square from the sides and to the mould, as before directed for sawing.

The tables may next be trimmed out of the scarph thus: strike a line along the middle of the depth; then, from the end or lip of the scarph, square over six inches from the said line; for the lap at the lip next beyond that, square over six inches more, for a coak; and, from thence may be squared the butt of each tabling, which may be in length about once-and-a-half the depth of the beam, and so disposed as to raise a tabling at the upperside of the beam at each lip, to hang the lip or give it more support; the other tablings are taken out, or sunk at each edge, alternately. Hollow work must be avoided in trimming out the tablings, otherwise cavities will remain in the beams after they put together, which reduces the strength, and makes a lodgment for wet, which imperceptibly rots the beams. One preventative against the latter is, to take the tabling wholly through, making them dove-tail or strengthen each way.

The scarph thus trimmed, must be laid upon the scarph of the piece it is intended to join, the pieces set straight and out-of-winding, and to the round-up mould; then square down the butts of tabling and the coak at the end; and, with compasses, take the greatest distance the two scarphs may be asunder, and prick it down from the piece already trimmed to the other at the butts of the tablings, &c. and rase over the end; then prick down the line struck along the middle of the tablings, and line each side of the unfayed piece to the marks thus given, and proceed to trim it out as directed for the first scarph. The surface of each scarph, if correctly trimm'd, may then be tarred, and have hair laid regularly on the tar. The pieces may then be set close together with chains, and bolted with bolts, in size and number as given in the Table of Dimensions. The bolts to be spaced equally asunder, and half the heads driven from the lip of each scarph, and about three down or up from each edge. The points of the bolts to be clenched. The bolts may be of square iron. Each lip is drawn close by two nails. In the same manner may all the scarphs be performed, let the beam be composed of whatever number of pieces it may.

The length of the beams now only remains to be taken. The order or stations on the ship's side where the side of each beam is to be placed, is set off from the draught, which are, generally, that one beam comes under every port and one between. The *mast-rooms, hatchway*, and *ladderways*, and scuttles, considered. The lengths are generally taken as follow: stretch a line across the ship to the order on each side, at the beam-line; then, with a staff, or, what is better, *sliding battens* opened from side to side, in the direction of this line, and then a pencil stroke squared down each batten and the number of the beam marked thereon. The bevellings of the ends are next taken and marked upon a board, with the name of the beam and bevelling. Thus, for the fore and aft bevelling, fix the tongue of the bevel close to the side, with the range of the *beam line*, and the stock well with the straight line; then mark it and its name on the board. The *up and down* bevelling is taken by fixing the tongue of the bevel against the side and opening the stock until it is *out-of-winding* with the said line, marking that on the board. To be correct, prove these bevellings on the opposite side, marking down the alteration, if any. Thus may the bevellings of several beams be taken and marked upon the board. Now, to set off these lengths and bevellings as taken, strike a straight line along the upper part of the beam on the side the length was taken in the ship, (appropriating the beams as near to the lengths as possible to prevent waste) then, on this line, set off the exact length from the *battens*, and apply the bevellings at each end as taken in the ship.

This method is correct when the beams have their proper *round-up;* but the most exact method of taking the lengths is, to set back or upon the beam a four-inch spiling, or sirmark, from the order on each side, upon the beam line; then, to this sirmark stretch a line across, and proceed as before described. Next apply this length on the beam mould, to a straight line struck equally on each side the middle, marking exactly the ends of the *sliding* battens. Then open the battens to the said length on the round of the beam mould, marking this last length on the battens with pencil. On the beam, before this length can be applied, must be set back at each end the four-inch sirmark from a line ranged straight along the same side of the beam as in the ship; then lay the battens on the beam to the sirmarks, at the ends, keeping the battens straight along their middle. Next mark the ends of the battens exactly in each sirmark; and, rasing the sirmarks exactly on the beams, the bevellings are set off as before. When the beam is gotten on board, to be let down into its place, these sirmarks are made to agree; that is, the sirmarks on the side and on the ends of the beam: for, by the former method, you must be careful in letting down the beam, that the lip is kept clear of hatchways, &c.

After the ends are cut off they are scraped back on the underside so as to let down in the clamp what is directed in the Table of Dimensions, *wearing-off* at twice the depth of the beam. The ends are then *mouthed* to admit the air to the *heart* by cutting out an opening or mortice about two-inches wide, and as much within the clamp on the underside and *wearing-off* at the upperside of the beam, by that means the heart is opened by the *mortice* or *mouthing* to admit the air freely to the heart which is most apt to decay. The ends of the beams generally fay against the timbers, excepting the after beams of the lower deck, the clamps of which are obliged to *fly-up* to take the *sny out;* owing to the quick turn of the body abaft, those beams cut off against the clamps, and let in on their undersides. The platform beams, in like manner fay against the inside stuff.

The uppersides of piece-beams should be caulked in the scarphs as soon as crossed in their places.

KNEES. The knees are first sawed or trimmed to the siding given in the dimensions; then fayed to their respective places by a mould and bevellings, taking as little wood as possible out of the throat the moulding way; the strength of the knee being there. Towards the toe each tapers to what it is sided. No chock should be admitted on any knee that would reduce the throat or moulding of the knee less than its siding.

Lodging and *Dagger Knees* should have a coak left at the crown, when the grain will admit, to let into the beams one inch and a quarter, at about nine inches from the side. The coak to be from four to six inches broad, and within one inch of the underside of the knee. When the grain will not admit of a coak, a hook is left, about nine inches long, within the toe. After the knees are fayed and bolted, an iron key may be driven down the side butt of the coak.

In bolting the knees, place the holes alternately on each edge, and the throat-bolts in the side arm of the hanging knees as high as possible, keeping the upper hole in the range of the underside of the beams, and stiving it upwards to come through the end of the lodging-knee behind it, and the next hole about four inches below it, stiving it rather above a level. The other holes are to be equally spaced between that and the toe hole, which is kept up full the siding from the end, and may be bored square with the body or to clear the seams. *(See Midship Sections, Plate III.)*

In those parts of the ship afore and abaft, where wood knees cannot be procured of kindly growth, (for upon that depends the strength) knees of iron are generally placed. These, although they are now much used, particularly in merchant ships, cannot be so fully depended on as those of wood, because they cover less surface, are by no means flexible, nor can the bolts be driven so tightly in the iron as in wood. If, therefore, the ship strains, they must inevitably work loose: again, the holes must be bored in the direction in which the knees are punched, so that, where iron knees are intended to be placed, oak fillings should be driven between the timbers; otherwise the bolts may come in the openings, which is inadmissible. Besides this, the bolts may happen to come in the seams of the outside plank; when it so happens, the best way is to cut out a piece and clench the bolt upon the timbers.

Bolts in wood knees are driven from the outside and clenched upon the knees inside; but bolts in iron knees are driven from the inside, with collar or stout heads; because, upon the head depends its fastening. Or, if the bolts be of copper, they must have a ring under the head, and the head spread or made large in driving. All bolts driven from the inside should be carefully clenched upon rings, let flush into the planks, by means of a bitt for that purpose, and the points caulked after the ring is let in.

Wood for knees having, from its peculiar figure become scarce, many substitutes have been attempted, and iron knees, or, rather, knees formed conjointly of iron and wood, as described hereafter, are certainly the best, when properly applied. *(See Plate III.)*

Made-knees of wood have been constructed by foreigners, of straight pieces lapped together at the crown, and a chock fayed into the throat.

STANDARDS. Standards are sided, trimmed, and fayed, similarly to knees; but, if of wood, the toe-bolt of the deck arm should have a collar-head, and be driven through an iron plate under the head; or, which is better, through an iron strap, clasping the toe with a fore-and-aft bolt driven to prevent the standard's splitting. The point of the toe-bolt should be screw-cut to receive a nut, which should be hove taught upon an iron plate let up its thickness in the underside of the beam.

RIDERS. Riders are sawed to the mould and bevellings, and to the size given in the Dimensions; then fayed by a mark, or a square spot, and counter moulded, and then bolted through the side alternately on each edge, with the bolts equally distant. Floor riders, according to the present mode, require large pieces of oak timber. Their strength is much reduced by crossing the keelson, although very often the grain is straight at the score. We should therefore consider it as better work for the floor riders to be in two, with a cross chock fayed over their heels with a hook and butt scarph; also with their heels to work down to the limber-boards and the heads between the joint of the floor-head and first futtock head. For, at present the head of the floor rider (after taking so large a piece of timber) only comes over the joint of the floor-head, or nearly so; but, by the method here proposed, the floor-head will be more succoured by the floor-rider's running beyond it.

First futtock riders are sawed and fayed as before described. They fay close to the sides of the floor riders, and the heels extend downwards within four feet of the keelson. The head runs up between the joint of the first futtock head and underside of the orlop beam, with a cross chock over the heels and a hook-and-butt scarph. A piece may be worked from the heels to the limber boards to straighten the cross chock.

Second futtock riders are sawed and fayed as before described, and scarph with a hook scarph under the head of the floor riders, or connect thereto with a chock. Their heads run up within two inches of the underside of the gundeck beam, and are cut with a swell at the orlop beam, to which they tail-sideways; and they bolt fore and aft with two bolts, and likewise fay and bolt against the side of the first futtock rider.

Third futtock riders are sawed and fayed, as before described, with a swell, to tail and bolt against the sides of the gundeck beams. They fay and bolt, fore and aft, the sides of the second futtock riders. The heads come up within two inches of the underside of the upper or middle-deck beams, and the heels come within two inches of the upperside of the orlop beam.

Breadth riders are similar to third futtock riders. They are cut with a swell to bolt against the beams they fay to, and their lengths are the distance between the beams or decks above and below them.

Top riders are similar, and cut with a swell to bolt to the upper-deck beams. Their heads run up to the underside of the gunwale, and the heels about six inches short of the gun or middle deck.

Breadth and top riders stand diagonally, and thereby bolt to more timbers, and clear the ports better than the rest.

BREASTHOOKS, STEPS, and CRUTCHES. These are sawed to the given dimensions, and fayed similar to knees and riders. But, if a mark is taken for faying the breasthooks, it must be taken in a fore-and-aft direction, or parallel to the middle line; and, for steps and crutches, perpendicularly. For, were the mark taken parallel to, or square with, the body, too much would be taken from the extremities; and, consequently, would never fay. The holes for the bolts are bored alternately, near the edges, and equally asunder. The holes next the middle line of breasthooks, in the sharp part of the body, are crossed, to bring them more square with the bow. Breasthooks, Steps, and Crutches, are assisted in the moulding by chocks, and the deck-hooks may be assisted by eke-ings, worked behind them, so that the hooks may seat against the stemson. All the chocks of breasthooks are tabled, and ought, on no account, to have less wood or substance than the siding left clear of the chocks.

COAMINGS and HEAD-LEDGES for framing the hatchways, &c. are sawed to the size given in the Table of Dimensions; then framed together in the strongest manner, by lapping them at the ends over each other, to dovetail each way, and the coamings to have five-eighths of an inch tail or stop into the head-ledges, taking the rabbet for the gratings out first. The head-ledges come wholly through under the coamings, and sufficiently above the deck to be caulked; above that the coamings lap over the head-ledge. A bolt is driven through each corner, in the middle of the lap, and one in the middle of the head ledge. Coamings have a rabbet taken out of the inner edge, for the gratings, about three inches on and two inches and three quarters deep. The coamings are mostly fastened with treenails, and the corners are rounded off above the deck.

CATHEADS. Catheads are first sawed to their cast and flight, and then trimmed with more exactness to their moulds and scantlings, as in the Table of Dimensions. Their outer part is cut to look up with the sheer, the sides standing perpendicular or plumb. Their outer ends cut off between a perpendicular and a square, and are secured with an iron hoop, let in flush. The sheeve holes are then cut through perpendicularly and parallel to the sides. The inner part is fayed to the cat-beams, in large ships, with a scarph on the upper side for the cat-tail to fay to, with a hook butt in the middle. In smaller ships, the inner part fays up to the underside of two or more of the forecastle beams, facing upwards one inch or more.

SUPPORTERS OF THE CATHEADS. The Supporters are generally trimed, as the side-arms curve very much, by a mould made to the aftside. Some trim it by two moulds; one mould being made to the curve on the side, another to fay to the underside of the cathead, and likewise to the side in a straight direction. By this method the supporter may be trimmed near enough for a rough mark. Others take the pains to fasten brackets to the side, to its curve, at about six inches asunder; the aftsides of which gradually wind, or twist, from the aftside of the cathead to look in with its rail at the fore part. Then, to the outsides of these brackets are fayed pieces of deal, scarphed together, by which means the curve on the aftside is truly obtained, and likewise the shape of the side to which it is to fay; and, as the brackets stand square from the flight, or curve, they give the true bevellings to trim it to. By this mould the supporter may be trimmed very nearly to its work, and may then be sided and moulded correctly, and set up into its place.

KNEE OF THE HEAD. The Knee of the Head has its several pieces sawed to their various shapes given on the mould, and the tapering sideways where they cross the battens.

The main piece should make the lower part of the knee, and run up in front to take the bobstay holes. Another piece must be provided to make the lacing, and a third to fay against the stem, and run up high enough for a hole to be cut in it to receive the main-stay collar. The other pieces between may then be provided, as most convenient, marking on the mould the shape of each piece as provided, allowing to each sufficient wood for tabling and faying.

The main piece has the fore part trimmed to the mould, and then sided, agreeably to the tapering battens, from a middle line rased along the piece and over the ends. The edges on the fore part are next trimmed off with a bold round. This piece is then secured on blocks, and kept perpendicular with the middle line. The tables may now be taken out of the aftside. Each piece is then gotten on and fayed as before described, and treenailed to each other till the whole surface of the knee is completed. The aftside is then fayed to the stem.

The knee-bolts may next be set off where they are intended to be driven, and quartering nailed between to keep the whole together while hoisting into its place. The holes may then be bored, first marking every appearance of iron, &c. behind. Some prefer having the bolts to go through the middle of the hooks, as it makes the bolts more of an equal length through the side. Others prefer having the bolts so as to come between the hooks, alledging for this practice that more fastening is obtained, and the difficulty of driving the bolts without that additional length obviated. But, after all the holes are bored, let the knee be swung off, and carefully examined behind, so that, in case there should then be any holes, they may be carefully plugged up and caulked. The knee and stem may be then paid well with tar, and set close with chains while bolting, as it is sometimes apt to start off.

RUDDER. The main piece of the rudder is sawed to its siding, and the upper part to the given dimensions, with the lower part moulded as large as the piece will admit. Whatever the main piece may require to complete its foreside must be of oak or elm, tabled to the main piece. The foreside may be then bearded from the side of the pintles, the foreside being trimmed to the form of the pintles from a middle line, correctly rased the whole length, and squared over at the ends; for, were it bearded to a sharp edge at the middle line, it would reduce the main piece more than is required; and we may observe, that, in large ships, when the rudder is hard over, the bearding will not be close to the stern-post by three-quarters of an inch. The usual mode is, to line down, on each side of the main-piece, two-fifths of its thickness; but this has been found to cut or wound the main-piece so much at the upper pintle, that, lately, the aftside of the stern-post is likewise bearded; and, consequently, the foreside of the rudder so much the less. The other pieces, to complete the surface of the rudder, may be of fir, and table on to the main-piece and to each other. The whole is then trimmed straight through, to its thickness on the aftside, and then bolted together between the straps of the pintles. The back is then fayed on and fastened to the aftside, and the sole at the heel, (when cut off to its length), with nails and treenails. The hances are then trimmed out to mouldings, and the aftside of the rudder above the lower hance is thirded and bearded back about three-quarters of an inch at the sides. The head, if not a round headed rudder, has its edges taken off with a bold round. The holes for the tiller may be now cut through, and the head hoops driven on. The pintles may next be let on thus: the braces being let on to the stern-post, and square from the aftside, a staff of the whole length, is run down through the holes of the braces, or fastened to the aftside. The former method is that which we prefer. Now mark the uppersides of the braces correctly on the staff, with a pencil, or both under and uppersides will be best. Then mark on the staff the upperside of the wing-transom and the under side of the deck-transom above; also the upperside of the deck; and, lastly, the underside of the keel. Next apply the staff on the foreside of the rudder, and exactly mark off the uppersides of the braces in the middle line, keeping the transoms clear of the holes, that the lower tiller may work near the undersides of the deck beams above the wing-transom. Then square down, from the foreside of the rudder, the upperside of each brace, which, it may be observed, is the underside of the pintles. Now set upwards the breadth of the straps, and the scores may be taken out till the crowns come flush with the bearding, and the middle of the pintle ranges well with the middle line, allowing for the upper sheathing round the scores under the pintles. Scores are then gouged out, under the pintles, sufficiently for hanging the rudder, and may be formed by a piece of sheet-lead, made to the crown of each brace, and traversed round its respective pintle. Let there be sufficient room in the scores to allow for the sheathing; and, that the rudder may hang easily, all the scores must be made to the length of the lower one; that pintle being two inches longer than the others. The score nearest to the load water mark is opened on one side to fit in the woodlock which prevents the rudder from unhanging. At some places in the North of Britain, the pintles are put into the braces, and the rudder put together in that situation, so that it cannot be unhung until throatings are cut to clear it of the braces.

After the braces are let on, it is best to try all the pintles in them, and see that they work easily in the braces, and square from the stern-post. Then their uppersides may be taken with a staff, and set off on the rudder, as before directed, without the possibility of error. The tiller and sweep may next be fitted agreeably to the directions already given for constructing the plan of the upper deck.

OF FINDING THE TONNAGE OR BURTHEN OF SHIPS, &c.

By the *Tonnage* is generally understood the burthen of a vessel as computed by an established but very defective rule, which we shall presently give, producing what is usually called *Builder's Tonnage*, in contra-distinction to the true tonnage.

By this rule, all vessels, whether their bodies be extremely full or extremely sharp, will appear to be precisely of the same burthen or capacity, if the length of keel and extreme breadth be similar. Thus, the sharpest cutter will seem to carry as much as the fullest merchant-ship of the same length and breadth extreme. This method is, of course, exceedingly detrimental to that principle which promises velocity; as the ship which is narrowest above, and widest and deepest below, will measure least in proportion to her real capacity; the very reverse of which is necessary for fast sailing.

In order to ascertain the true burthen of a ship, we ought to find the place of the light-water line, and thence calculate the number of cubic feet below the line of floatation: as the product, deducted from the number of cubic feet contained at the load-draught, would shew the real capacity by which the tonnage may be computed: and, if the difference be multiplied by the weight of a cubic foot of sea water, 64¼lbs., the product, divided by 2240 (the number of lbs. in a ton), will give the true burthen in tons.

Or, in other words, by deducting the weight of the ship at her light-water mark from her weight when brought down to the load-water mark, the remainder will be the tonnage.

THE GENERAL RULES OBSERVED FOR MEASURING THE TONNAGE OF SHIPS, IN THE KING'S AND MERCHANTS' SERVICE, ARE AS FOLLOW.

1. Let fall a perpendicular from the foreside of the stem, at the height of the hawse-holes *, and another perpendicular from the back of the main post, at the height of the wing transom.

2. From the length between these perpendiculars, deduct three-fifths of the extreme breadth †, and likewise as many 2½ inches as the wing transom is high from the upper edge of the keel, and the remainder is accounted the length of the keel for tonnage.

Then multiply the length of the keel for tonnage by the extreme breadth, and that product by half the extreme breadth; then, dividing by 94, the quotient will be the burthen in what is denominated Builder's Tonnage.

Or, Multiply the length of the keel for tonnage by the square of the extreme breadth, and divide the product by 188, the quotient will be the burthen in tons.

The Rule made use of by the Officers of the Customs, for the computation of Tonnage Duties, for all vessels, excepting coal-vessels, is established by the act of parliament 13 Geo. III. c. 74, as follows:

The length shall be taken on a straight line along the rabbet of the keel, from the back of the main stern-post to a perpendicular line from the fore part of the main stem under the bowsprit; from which, subtracting three-fifths of the breadth, the remainder must be esteemed the just length of the keel to find the tonnage; and the breadth shall be taken

* In the merchant-service, this perpendicular is let fall from the foreside of the stem, at the height of the wing transom, by reason of the hawse-holes being generally so very high, and their stems also having a great rake forward.

† By the extreme breadth, is meant the breadth taken from timber to timber outside, with the thickness of the bottom on each side added; or, which is the same thing, the thickness of the bottom on each side added to the moulded breadth.

from the outside of the outside plank in the broadest place in the ship, be it either above or below the main wales, exclusive of all manner of doubling planks that may be wrought upon the sides of the ship; then, multiplying the length of the keel by the breadth so taken, and that product by half the breadth, and dividing the whole by 94, the quotient will be deemed the true contents of the tonnage *.

RULES BY MR. PARKYNS, LATE OF HIS MAJESTY'S YARD, CHATHAM.

RULE I. *For sharp Ships, particularly those of the Royal Navy.*

1. Take the length on the gun-deck, from the rabbet of the stem to the rabbet of the stern-post, or between the perpendiculars. Then take $\frac{23}{24}$ of this length, and call it the *keel for tonnage.*

2. To the extreme breadth add the length of the gun-deck, or length between the perpendiculars; then take $\frac{1}{25}$ of this sum, and call it the *depth for tonnage.*

3. Set up this depth from the limber strake; and, at that height, take a breadth also from out to outside of the plank at dead-flat, and another breadth between that and the limber strake; add together the extreme breadth and these two breadths; take one-third of the sum, and call it the *breadth for tonnage.*

4. Multiply the length for tonnage by the depth for tonnage, and the product by the breadth for tonnage, and divide by 49. The quotient will be the burthen in tons nearly.

The following trials have been made to prove the accuracy of this rule:

		Tonnage by the King's or common rule.	*Tonnage by Mr. Parkyns's rule.*	*Tonnage actually received on board.*
VICTORY, of	100 guns	2162	1839	1840
LONDON	90	1845	1575	1677
ARROGANT	74	1614	1308	1314
DIADEM	64	1369	1141	965
ADAMANT	50	1044	870	886
DOLPHIN	44	879	737	758
AMPHION	32	667	554	549
DAPHNE	20	429	329	374

RULE II. *For Ships of Burthen, or Commercial Ships, in general.*

1. Take the length of the lower deck, from the rabbet of the stem to the rabbet of the stern-post; then take $\frac{31}{32}$ of this length, and call it the *keel for tonnage.*

2. To the extreme breadth add the length of the lower deck; then take $\frac{3}{55}$ of the sum, and call it the *depth for tonnage.*

3. Set up this depth from the limber strake; and, at that height, take a breadth also from out to outside of the plank at dead-flat. Take another at two-thirds of this height, and another at one-third of the height. Add the extreme breadth and these three breadths together, and take one-fourth of the sum for the *breadth for tonnage.*

* For the method of determining the exact tonnage of a ship, by her estimated weight, &c. see "Elements and Practice of Naval Architecture," page 211.

4. Multiply the length for tonnage by the depth for tonnage, and the product by the breadth for tonnage, and divide by 36.6666 or $36\frac{2}{3}$, and the quotient will be the burthen in tons.

The following trials among many others, shew that this rule does not deviate far from truth.

	Tonnage by the King's or common rule.	Tonnage by Mr. Parkyns's rule.	Tons actually received on board.
GRANBY, East-India ship	786	1179	1179
NORTHINGTON, East-India ship	676	1053	1064
UNION, a collier	193	266	289
FRIENDS' GOODWILL, a collier	182	254	277

THE GENERAL RULE FOR CALCULATING THE LOADING OF COLLIERS IS AS FOLLOWS:

From the length of the keel subtract six or seven feet for the dead stowage fore and aft; multiply the remainder by the breadth of the frame, and that product by the depth of water the ship draws when loaded; divide this by 96, and you will have the number of London chaldrons the ship will carry.

We shall now subjoin the following

EXPERIMENTAL METHOD OF FINDING THE TONNAGE OF A SHIP.

Construct an accurate model, agreeably to the draught of the proposed ship, to a scale of about one fourth of an inch to a foot, and let the light and load water lines be marked on it. Then put the model in water, and load it until the surface of the water is exactly at the light-water line; and let it be suspended until the water drains off, and then weighed. Now, since the weights of similar bodies are in the triplicate ratio, or as the cubes, of their homologous dimensions, the weight of the ship when light is, therefore, equal to the product of the cube of the number of times the ship exceeds the model by the weight of the model, which is to be reduced to tons. Hence, if the model is constructed to a quarter of an inch scale, multiply the weight of the model by the cube of 48 * or 110592, which will give the weight of the ship. If the multiplier be ounces, the product will be ounces; if pounds, it will be pounds; and is to be reduced to tons accordingly.

EXAMPLE.—Suppose the weight of a model to be 30lbs. or 480 oz.

The cube of 48	110592
Multiplied by	30 lbs. or 480 oz.
Produces	3317760 lbs. = 1481 tons 320 lbs.

The operation may be considerably abridged by logarithms, thus:

If the weight be expressed in ounces, then, to the constant logarithm 0.4893557 add the logarithm of the weight of the model in ounces; and the sum will be the logarithm of the weight of the ship in tons.

* One-fourth of an inch being equal to 1-forty-eighth of a foot.

EXAMPLE.—To the constant logarithm	0.4893557*
Add the logarithm of 480 (ounces)...	2.6812412
Produces the logarithm of 1481.2 nearly; ...	3.1705969

Again, the model is to be loaded until the surface of the water coincides with the load-water line. Now, the model being weighed, the weight of the ship is to be found by the preceding rule: then, the difference between the weights of the ship when light and loaded is the tonnage required.

A MECHANICAL METHOD OF FINDING THE CENTRE OF GRAVITY IN A SHIP.

THIS method of finding the centre of gravity is exactly similar to the experimental method described above for finding the tonnage, by the construction of a model to a scale of one quarter of an inch to a foot of the corresponding parts on the ship; and care must be taken to provide the wood as light as possible. The same model will, of course, answer both purposes.

The model being accurately constructed, may be suspended by a thin line or silk, in different positions, until it points out the centre of gravity; which will be found when the block hangs in a state of equilibrium: this practice is, doubtless, very simple, but it will be found very convenient.

Many useful discoveries may be made by models or blocks, and with as great certainty as by the nicest calculations; for it must be allowed, that, in calculating from a draught by a quarter scale, it will be liable to some inaccuracies which cannot be obviated in practice, by reason of various little alterations which may be made in laying the ship down in the mould loft; consequently, the draught and the ship will in those points disagree. And likewise, upon strict examination, we shall be enabled to find, that there are very few ships that have both their sides exactly equal in every respect.

In order to prove our block, we may suspend it by a line fastened to a hook in any part of a straight line drawn from the middle line of the stem to that of the post; this hook may be moved forward and aft to different places in the middle line, and a weight may be suspended from the upper part of the middle line on the post; if the two sides be exactly of equal dimensions and homogene, they will then be of equal weight: a plane passing through these three lines, whatever part of the middle line the hook be in, will likewise pass through the middle line of the keel, stem, and post. Therefore, if our model stands this proof, it will be as true to work from as the nicest calculations.

The model being suspended by the hook, the lines hanging at the stem and post corresponding to their middle lines, and to that which suspends the block, we may hold a batten out of winding with the line that suspends it; and, with a pencil, draw a line upon it; a plane passing through this pencil line, at right angles to the keel, and passing likewise through the line that suspends the block, will likewise pass through the centre of

* The constant logarithm is found by subtracting the logarithm of 35840, the number of ounces in a ton, from the logarithm of the cube of 48, or 110592.

gravity, which, therefore, must be somewhere in this plane. Again, move the hook to some other part in the middle line, and let the block be suspended from that point; draw also another pencil line, out of winding with this last line of suspension, and the intersection of the two lines will give the height of the centre of gravity above the keel, and likewise its distance from the post and stem; and, if the hook be moved to any other parts of the middle line, and a pencil line be drawn as before, it will likewise intersect in the same point; or, let there be ever so many points assumed in the middle line, and the block suspended by each, and pencil lines drawn, they will all intersect in the same point; and, as the centre of gravity will always be in that plane which passes through the middle line of the keel, stem, and post, it may with certainty be marked on the draught.

This will certainly require the utmost nicety; but, if well executed, will be found correct, provided the dimensions be taken very exactly, and from a true scale of equal parts.

TABLES

FOR

FORMING THE BODIES

OF SEVERAL

SHIPS AND VESSELS

IN THE

ROYAL NAVY AND MERCHANT SERVICE.

VIZ.

A SEVENTY FOUR GUN SHIP;
A FRIGATE OF THIRTY SIX GUNS;
A MERCHANT SHIP OF 330 TONS;
A BRIG OF 170 TONS; AND
A SLOOP OF SIXTY TONS,

TOGETHER WITH

TABLES OF ALL THEIR PRINCIPAL DIMENSIONS AND SCANTLINGS;

AND ALSO,

THE DIMENSIONS AND SCANTLINGS OF BOATS.

BODIES OF THE SHIP OF 74 GUNS AND 1828 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers.....	⊕		B		F		K		O		S		U		X	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular	66	0	60	6	49	6	38	6	27	6	16	6	11	0	5	6
Lower height of breadth........................	21	3	21	3	21	4	21	8¾	22	7¾	24	3¼	25	5½	27	1
Upper height of breadth........................	23	4	23	4	23	4¼	23	5½	24	0	25	3	26	2¼	27	6
Height of the top-timber line	35	4	35	5	35	8	36	0¾	36	6½	37	2	37	6½	38	0
topside line........................	...		...		57	10	38	2¾	38	8½	39	4	39	8½	40	2
cutting down line..................	1	10	1	10	1	10¾	2	2	2	10¾	4	8	6	6		
rising line *........................	11	6	0	4	3	6¼	9	10¾								
Main half-breadth...............................	24	0	24	0	24	0	23	10¾	23	0	20	3¼	17	5¼	12	6
Top-timber half-breadth........................	20	8	20	8	20	8	20	5½	19	11	18	8½	17	8¼	16	3¼
Topside half-breadth............................	20	3	20	3	20	3	20	1½	19	8	18	7½	17	8¼	16	3¼
Rising half-breadth..............................	8	6	8	4¼	8	9	2	8								
Length of the lower breadth sweep............	18	6	18	4	18	0	17	0	15	7	14	0	13	0	12	0½
upper breadth sweep............	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0
floor sweep above the rising...	See rising line.															
Length on the first diagonal line................	8	1¾	8	1½	8	0	7	7¾	6	10½	4	11	2	11		
second diagonal line............	12	10½	12	9½	12	4¾	11	5½	9	10¾	7	3½	5	2	1	9
third diagonal line..............	17	6	17	4¼	16	7½	15	2¾	13	0	9	9½	7	4½	3	5½
fourth diagonal line............	21	0¼	20	11¼	20	5¼	19	0¼	16	5½	12	6¾	9	9½	5	7½
fifth diagonal line...............	21	11¾	21	11	21	7½	20	7¼	18	3¼	14	4	11	2	6	9
sixth diagonal line..............	22	9¼	22	9¼	22	7	21	10½	20	0¼	16	1½	12	8½	7	11½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st	2d	3d		4th	5th	6th		4th	5th	6th
Height up the middle line	7 8	10 9	13 8¾	In the Fore Body.	16 5¾	17 10	19 2	In the After Body.	21 9	24 8	27 1¾
Distance from the middle line on the base line or upper edge of the rabbet	3 10	8 0½	13 0½		...	...	...		22 3½		
Height up the side line	...	...	...		0 3½	5 1¼	6 6½		...	3 10½	8 5¼

IN THE AFTER BODY.

Numbers of the Timbers	4	8	12	16	20	24	28	32	34	36
Station from the after perpendicular	93 6	81 2	70 2	59 2	48 2	37 2	26 2	15 2	9 8	4 2
Lower height of breadth	21 3	21 3	21 3½	21 5	21 8¾	22 4	23 3	24 7¼	25 5½	26 5½
Upper height of breadth	23 4	23 4¼	23 5	23 6	23 8½	24 0½	24 7½	25 6	26 1	26 9¼
Height of the top-timber line	35 4	35 6½	35 9¼	36 2¼	36 8¼	37 4¼	38 2¼	39 1½	39 8	40 2¼
topside line	...	38 6½	39 3¾	39 8¼	40 2¾	42 0¾	42 10¼	43 9½	44 4	44 10¼
cutting down line	1 10	1 10	1 10¾	2 0¾	2 5¾	3 3¼	4 8½			
rising line *	0 5½	1 4½	2 6½	4 8½	8 0	13 0				
Main half-breadth	24 0	23 11½	23 11	23 8¾	23 3	22 6	21 5	19 11	18 10¼	17 7½
Top-timber half-breadth	20 8	20 8	20 6½	20 4½	19 11¾	19 2	18 0½	16 7½	15 9½	14 10¼
Topside half-breadth	20 3	19 10½	19 9	19 7	19 3	18 6	17 3	15 9	14 11	14 2
Rising half-breadth	8 4	8 0	7 4	6 2	4 1¾	0 8				
Length of the lower-breadth sweep	18 6	18 4	18 3	17 8	16 6¾	15 1½	13 3¼	11 0	9 2½	6 9½
upper breadth sweep	15 0	15 0	15 0	15 0	15 0	15 0	15 0	15 0	15 0	15 0
floor sweep above the rising	See rising line.									
Length on the first diagonal line	8 1¾	8 1½	8 0¼	7 9	7 3¼	6 5	5 2½	3 6¼	2 6	1 2
second diagonal line	12 10½	12 8⅞	12 4¾	11 9¼	10 10¼	9 5½	7 6¼	5 0	3 4½	1 6½
third diagonal line	17 6	17 2¾	16 8¼	15 11	14 8½	12 10¾	10 3½	7 0½	4 10½	2 3½
fourth diagonal line	24 4	24 3	23 10½	23 1½	22 0¼	20 2½	17 5¼	13 10	11 4½	7 7½
fifth diagonal line	25 10	25 9½	25 6¼	25 0	24 1	22 5½	20 0	16 8½	14 3½	10 5
sixth diagonal line	26 9¼	26 9¼	26 7	26 2	25 4½	24 0	22 0½	19 2	16 11½	13 7¼

* Rising height is 11 feet 6 inches at dead-flat; above which, all the other rising heights must be set off.

BODIES OF THE FRIGATE OF 36 GUNS AND 877 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers	⊕ ft.	⊕ in.	C ft.	C in.	G ft.	G in.	L ft.	L in.	P ft.	P in.	T ft.	T in.	W ft.	W in.	X ft.	X in.
Station from the foremost perpendicular.......	61	7	49	7	39	11	30	3	20	7	10	11½	6	1½	3	8½
Lower height of breadth.........................	17	3	17	4¼	17	9¼	18	6½	19	11	22	1½	23	8	24	7
Upper height of breadth........................	18	11	18	11½	19	1	19	6½	20	7½	22	6	23	11¼	24	9½
Height of the top-timber line....................	27	0	27	0	27	0½	27	3½	27	7	28	0½	28	4½	28	7½
topside line	...		...		...		29	1¼	29	5½	29	10½	30	3	30	6
cutting down line.................	1	8	1	8	1	8	2	0½	3	0½	5	0½	6	8		
rising line *...	12	0	1	0	4	9½	13	10								
Main half-breadth..............................	18	10	18	10	18	10	18	5½	17	1½	13	9	10	7½	8	3
Top-timber half-breadth........................	16	9	16	9	16	9	16	6	15	9½	13	7	11	1	9	1
Topside half-breadth...............	...		...		...		16	2½	15	8	13	9½	11	7½	9	10
Rising half-breadth..............................	4	3½	3	7	0	9										
Length of the lower breadth sweep............	14	2	13	8	13	1	12	8	12	9	13	5	14	0	14	0
upper breadth sweep............	11	3	11	3	11	3	11	3	11	3	11	3	11	3	11	3
floor sweep above the rising....	See rising line.															
Length on the first diagonal line...............	9	4	9	3	8	10	7	11¼	6	6½	4	2	2	1	0	8
second diagonal line............	13	11½	13	9	13	1	11	10½	9	10½	6	9½	4	4½	2	8½
third diagonal line.............	17	0	16	10	16	2¼	14	11½	12	10¼	9	4½	6	6½	4	7
fourth diagonal line............	19	4	19	1½	18	8	17	7½	15	7½	11	9½	8	8	6	5½
fifth diagonal line..............	20	10½	20	9	20	5	19	6	17	7½	13	8½	10	4	7	11

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th		5th		6th	
Height up the middle line	8	0	12	0	15	8	19	2½	22	2	28	0
Distance from the middle line on the base line or upper edge of the rabbet	7	4	13	2	18	1						
Height up the side line	...		...		...		3	8½	7	10½	11	8

IN THE AFTER BODY.

Numbers of the Timbers	7		11		15		19		23		25		27		29		30	
Station from the after perpendicular	58	5	48	9	39	1	29	5	19	9	14	11	10	1	5	3	2	10
Lower height of breadth	17	5½	17	9½	18	5	19	3	20	4	20	11½	21	8½	22	9	22	11
Upper height of breadth	18	10½	19	1	19	5½	20	1½	20	11	21	6	22	1	22	6	23	1½
Height of the top-timber line	27	4	27	8	28	1	28	8	29	4	29	8½	30	2	30	6¼	30	9¼
topside line	29	1½	30	0½	30	6	31	1	31	9½	32	1¼	32	7	33	0	33	4
cutting down line	1	8	1	10	2	4½	3	6	5	4½	6	10½	8	9	11	0		
rising line *	2	2½	7	10	18	0												
Main half-breadth	18	9	18	6½	18	1½	17	5	16	5	15	9	15	0	14	0	13	7
Top-timber half-breadth	16	8½	16	6½	16	1	15	5	14	6	13	11	13	3½	12	7	12	2½
Topside half-breadth	...		16	3	15	8½	15	0	14	1	13	6¼	12	11	12	2½	11	10½
Rising half-breadth	2	7¼	1	8	Outside.													
Length of the lower breadth sweep	12	7	12	0	10	6	9	1½	7	7	6	9	5	9½	4	6	3	9
upper breadth sweep	11	3	11	3	11	3	11	3	11	3	11	3	11	3	11	3	11	3
floor sweep above the rising	See rising line.																	
Length on the first diagonal line	8	10	8	3	7	1	5	6½	3	9	2	10	1	11½	1	1½	0	8
second diagonal line	13	4	12	5	10	10	8	9½	6	4	5	0	3	6½	2	0	1	2
third diagonal line	16	4¼	15	5½	13	10½	11	10½	9	2	7	7½	5	9½	3	8	2	3
fourth diagonal line	18	10¾	18	8	16	8	14	9½	12	3	10	8	8	9½	6	3½	4	6
fifth diagonal line	20	8	19	11	18	0	17	2½	14	11	13	5½	11	8	9	2½	7	4½
sixth diagonal line	...		...		...		...		19	2	18	0	16	7¼	14	9½	13	5½

* Rising height is 12 feet at dead flat; above which, all the other rising heights must be set off.

BODIES OF A MERCHANT SHIP OF 330 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers ...	⊕		D		H		M		O		Q		R	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular......	42	8	32	4	23	8	15	0	10	8	6	4	4	2
Lower height of breadth........................	15	1	15	3½	15	9½	16	9½	17	5½	18	3½	18	9
Height of the top-timber line..................	22	7½	22	9	23	2	23	10½	24	5	25	0	25	5
topside line	...		...		24	4	25	0½	25	7	26	2	26	7
cutting down line..............	1	4	1	5	1	8	2	3	3	3				
Main half-breadth	13	6	13	6	13	4½	12	9	11	10	10	2	8	5
Top-timber half-breadth........................	12	0	12	0	11	10½	11	7½	11	3	10	3	9	0
Topside half-breadth	...		...		11	10½	11	7½	11	2½	10	3½	9	1½
Length on the first diagonal line..............	6	2½	6	0½	5	8½	4	10½	3	6	1	1		
second diagonal line	10	4½	10	1½	9	6	8	0½	6	5	3	10	1	8½
third diagonal line	13	1½	12	11	12	2½	10	4	8	7½	5	10½	3	7½
fourth diagonal line............	14	10	14	7½	14	1	12	1½	10	5½	7	8	5	3½
fifth diagonal line	15	5½	15	5	14	11½	13	8½	12	6	10	1	7	9
sixth diagonal line	15	5½	15	5½	15	1½	14	3½	13	3	11	0½	8	10

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th		5th		6th	
Height up the middle line	5	4	8	7	11	3½	13	4½	17	3	19	10½
Distance from the middle line on the base line or upper edge of the rabbet	4	6	8	4	11	2						
Height up the side line	...		...		...		4	6	9	7	12	6

IN THE AFTER BODY.

Numbers of the Timbers	4		8		12		16		20		24		25	
Station from the after perpendicular	50	4	41	8	33	0	24	4	15	8	7	0	4	10
Lower height of breadth	15	3	15	8	16	2	16	10½	18	0	19	3	19	7½
Height of the top-timber line	22	8½	23	0	23	5½	24	0	24	9	25	9	26	0
topside line	...		24	3	24	8½	26	4½	27	1½	28	0	28	3
cutting down line	1	4½	1	6½	1	11	2	7	4	9	6	1		
Main half-breadth	13	6	13	3	12	11	12	4½	11	7	10	6	10	2
Top-timber half-breadth	11	11	11	9	11	5½	11	0	10	4½	9	4	9	0½
Topside half-breadth	11	11	11	9	11	2	10	8½	10	0	8	11	8	7
Length on the first diagonal line	6	0	5	8	5	0½	4	0½	2	7	0	10½	0	6
second diagonal line	10	1½	9	6½	8	7	6	11½	4	6½	1	6½	0	10½
third diagonal line	12	10½	12	3½	11	2½	9	4½	6	6	2	9	1	9
fourth diagonal line	14	7	14	1	13	2½	11	5½	8	7	4	2	2	8½
fifth diagonal line	15	2	14	9½	14	3	13	2	11	4½	7	8	5	9
sixth diagonal line	15	2½	14	10½	14	5½	13	8	12	5	9	9	8	8

BODIES OF A BRIG COLLIER OF $170\frac{23}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers.....	⊕		D		F		H		K		L		M		N	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular......	30	0	22	5	18	5	14	5	10	5	8	5	6	5	4	5
Lower height of breadth........................	9	7	9	10	10	3	10	9¼	11	8	12	2½	12	10	13	9
Upper height of breadth........................	12	1¼	12	1½	12	2¼	12	6	13	0	13	4¼	13	9	14	3¼
Height of the top-timber line..................	16	4	16	4½	16	6	16	8	16	11	17	1½	17	4	17	8
topside line........................	...		...		17	3	17	5½	17	9	17	11¼	18	2¼	18	6
cutting down line................	1	2	1	2	1	3	1	6	2	2	2	11	4	4		
Main half-breadth................................	11	3	11	3	11	3	11	1¼	10	8	10	2	9	5½	8	1
Toptimber half-breadth..........................	10	6	10	6	10	6	10	4½	10	2	9	11	9	4½	8	4½
Length down the first diagonal line............	8	1	7	11½	7	8¼	7	3	6	3½	5	6½	4	6	2	6½
second diagonal line........	13	3	13	0	12	8	11	11	10	9	9	9	8	6	6	6
third diagonal line..........	17	7	17	5	17	0¼	16	2½	14	10	13	8¼	12	3½	10	3½
fourth diagonal line..... ...	17	3½	17	2	16	11	16	4½	15	3¼	14	4	13	0¼	11	2

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th	
Height up the middle line	7	4	12	3½	17	5¼	19	8¼
Distance from the middle line on the base line or upper edge of the rabbet	4	5½	7	5¼	10	7¼		
Height up the side line	...		...		...		6	0

IN THE AFTER BODY.

Numbers of the Timbers	4		8		12		14		16		18		20		22	
Station from the after perpendicular	38	11	30	11	22	11	18	11	14	11	10	11	6	11	2	11
Lower height of breadth	9	8	10	0¾	10	9	11	2¾	11	9½	12	6½	13	5¼	14	8¼
Upper height of breadth	12	2	12	4½	12	10¼	13	2½	13	7½	14	1¾	14	9	15	6½
Height of the top-timber line	16	5	16	7¾	16	11¾	17	3	17	6½	17	10¾	18	3½	18	9½
topside line	...		17	5¼	17	9	18	0½	18	4	18	8	19	0¾	19	7¼
cutting down line	1	2½	1	4	1	7	1	10	2	3¼	2	11¾	4	4¼		
Main half-breadth	11	2¾	11	1	10	10½	10	8¼	10	5½	10	2½	9	10½	9	5½
Top-timber half-breadth	10	5¼	10	3½	10	0½	9	10	9	7½	9	4¼	9	0	8	7
Length down the first diagonal line	7	11½	7	7½	6	10	6	3¾	5	6½	4	7½	3	2½	1	3
second diagonal line	13	0½	12	6	11	4¼	10	7	9	7	8	3½	6	6½	3	9½
third diagonal line	17	4½	16	10	15	7¼	14	9	13	9	12	5	10	8	7	11
fourth diagonal line	17	2	16	9½	16	1	15	5¼	14	9½	13	9¼	12	7¼	10	5

BODIES OF A COASTING SLOOP OF 60 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers.....	⊕		A		C		E		F		G	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station abaft the foremost perpendicular......	19	5	15	8½	11	5½	7	3½	5	2	3	0¼
Lower height of breadth........................	5	10	6	1½	6	7	7	4	7	11¾	8	9
Upper height of breadth........................	7	2	7	4½	7	8	8	3	8	7	9	1
Height of the top-timber line..................	10	10	10	11½	11	2½	11	6	11	9	12	0½
cutting down line..............	0	10	0	10¼	1	0¼	1	6				
rising line	0	5	0	6½	0	11	1	11	2	9½	4	3½
lower edge of the rabbet of the stem	...		...		...		0	2½	1	2	3	4
Main half-breadth..............................	8	3	8	2½	7	11½	7	3	6	5	4	9
Top-timber half-breadth........................	7	8	7	8	7	5	6	10	6	2	4	8
Length down the first diagonal line............	5	11	5	9½	5	2¾	4	2¼	3	1½	1	1
second diagonal line.........	7	5	7	3½	6	8½	5	7	4	4	2	3
third diagonal line...........	9	0	8	11	8	4	7	2¼	6	0	3	8
fourth diagonal line.........	9	10	9	9	9	3	8	2¾	7	1	4	10
fifth diagonal line............	11	0	10	11½	10	6	9	6	8	5	6	2½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th		5th	
Height up the middle line	4	6	5	10½	7	7	9	4	12	3
Distance from the middle line on the base line or upper edge of the rabbet	4	11½	6	4½						
Height up the side line	...		...		0	10½	3	2½	4	9

IN THE AFTER BODY.

Numbers of the Timbers	2		4		6		8		10		12		13	
Station from the after perpendicular	26	8	22	4	18	2½	13	11	9	10	5	7½	3	6
Lower height of breadth	5	10½	6	0½	6	4	6	10½	7	8	8	8½	9	4½
Upper height of breadth	7	2½	7	4	7	7	8	0	8	6	9	3	9	8¼
Height of the top-timber line	10	10	10	11½	11	2	11	5	11	9	12	3	12	7
topside line	...		...		11	6	11	9	12	1	12	7	12	11
cutting down line	0	10¼	0	11½	1	1¾	1	6	2	2	3	8		
rising line	0	7¾	0	11½	1	6	2	6	3	11½	6	0	7	7
Main half-breadth	8	1	7	11½	7	9¼	7	5	7	0	6	6	6	2
Top-timber half-breadth	7	8	7	6	7	4	7	0¼	6	8	6	2	5	9½
Topside half-breadth	...		...		7	3¼	6	11½	6	7½	6	1		
Length down the first diagonal line	5	8	5	3	4	7	3	9	2	8	1	3¼		
second diagonal line	7	2	6	9	6	0	5	0	3	9	2	2	0	9
third diagonal line	8	9	7	4¼	7	9	6	8	5	5	3	7	1	10
fourth diagonal line	9	7	9	4	8	11	8	1	7	2	5	5	3	8
fifth diagonal line	10	10	10	8¾	10	4	9	9	9	0½	7	10	6	11

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
LENGTH on the GUN DECK, or Lower Deck, from the rabbet of the Stem to the rabbet of the Stern-post	176 0	137 0			
Length on the RANGE of the DECK					
LENGTH from the forepart of the STEM, at the height of the Hawse-holes, in King's Ships, and at the height of the Wing Transom, in Merchant Ships, to the Aft part of the STERN-post at the height of the Wing Transom	179 5	140 8	103 3¼	76 3	52 0
LENGTH of the KEEL for casting the Tonnage	145 2	113 3	82 0	60 8	40 6
Length from the foremost perpendicular to the centre of Dead-flat	66 0	61 7	42 8	30 0	19 5
Length from the foremost perpendicular to the foremost timber expressed in the dimensions of bodies	5 6	3 8½	4 2	4 5	3 0¼
Length from the after perpendicular to the after timber expressed in the dimensions of bodies	4 2	2 10	4 10	2 11	3 6
LENGTH of the TREAD of the KEEL, viz. from the aft side of the Stem-post to the forepart of the Fore-foot.	160 5	126 2	92 0	66 3	44 6
LENGTH EXTREME, from the aft side of the Taffarel, at the height of the Fife-rails, to the fore part of the Figure or Stem	208 6	161 9	121 0	83 0	56 1
*** *The above lengths are taken with a line parallel with the Keel.*					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
BREADTH MOULDED	48 0	37 6	27 0	22 6	16 4
BREADTH EXTREME *	48 6	38 2	27 6	22 11	16 8
DEPTH IN HOLD, *taken from the strake next the Limber-boards*	19 6	13 4	12 0	10 0	9 8
BURTHEN in TONS (*Builder's tonnage*)	1828	877	330	170	60
LOAD DRAUGHT OF WATER — Afore	20 3	17 4	14 3	10 9	7 0
LOAD DRAUGHT OF WATER — Abaft	20 3	18 4	14 3	10 9	9 0
Height of the Lower Ports above the Water in Midships	6 0	7 8	6 2		
MAIN KEEL. Sided — *Afore at the Stem*	1 3	1 2	0 10½	0 9¼	0 7
MAIN KEEL. Sided — *Amidships*	1 6	1 4	1 0¼	1 0	0 10
MAIN KEEL. Sided — *Abaft at the Post or Rabbet*	1 3	1 1	0 10	0 9½	0 7
Deep	1 6	1 6	1 1	0 11½	0 10
Number of Pieces	*seven*	*six*	*four*	*two*	*two*
Scarphs in length	4 6	4 0	3 6	3 0	3 0
Lips of the Scarphs, *not more in thickness than*	0 5	0 4¼	0 3	0 2	0 2
Each Scarph to be bolted *with Bolts, in number*	*eight*	*six*	*six*	*six*	*six*
and diameter	0 1⅛	0 1⅛	0 1	0 0¼	0 0¼
FALSE KEEL.—False Keel, *to be deep or thick*	0 6	0 5	0 3	0 3	
DEAD OR RISING WOOD.—*To have a sufficient number of pieces of* Dead or Rising Wood *along the Midships, to seat the Floors, or to be thick*	0 8	0 7½	0 3	0 5	0 3
and broad	1 9	1 7	1 2	1 0	0 11
STERNSON OR KELSON KNEE, or Knee upon the Deadwood abaft, *to be made either by the after piece of Kelson, or to scarf with hook and butt upon the after piece of Kelson*					
The Arm against the Transoms *to reach to*					

* The thickness of the bottom plank on each side is only to be added to the Moulded Breadth to complete the Extreme Breadth.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
STERNSON OF KELSON KNEE, *continued, the upperside of the Deck or Wing Transoms*	*deck*	*wing*	*wing*		
The Fore and Aft Arm *to be in length*	20 3	16 0			
Tapered from the size of the Kelson to be at the Head	1 1	0 10½	0 8½		
To be bolted *with Bolts in number or distant from each other about*...	1 10	1 8	*seven*		
Diameter of the said Bolts	0 1½	0 1⅜	0 1⅛		
STEM CENTRE for sweeping the Aft side of the Stem.					
Above the upper edge of the Rabbet	23 9	18 6	16 0		
Abaft the foremost perpendicular	24 0	18 1	17 6		
Height of the forepart of the Stem above the upper edge of the Rabbet of the Keel	35 9	29 0	27 0	20 1	13 3
STEM.—The Stem to be moulded	1 5	1 3½	1 1	0 11	1 0
To be athwart-ships or sided at the Head	2 0	1 8	1 2	0 10	0 10
And to diminish from the Head to the lower side of the Lower Cheek to Upper Cheek	1 5	1 4	1 2		
To be sided at the Keel...	1 3	1 2	0 10¾	0 9½	0 7
Number of Pieces to make the Stem	*three*	*three*	*two*	*two*	*two*
Scarphs *to be in length* *	4 0	4 0	3 4	3 0	3 0
Lips of the Scarphs not to be more than	0 5	0 4⅛	0 3	0 2½	0 2½
Bolted *with Bolts in number*	*eight*	*six*	*six*	*six*	*six*
and diameter	0 1⅛	0 1	0 1	0 0¾	0 0¾
APRON,—The False Stem, or Apron, to be thick	0 11½	0 9	0 8	0 8	0 6½

* The Scarphs are to be tabled together with a Hook-butt, and tarred Flannel is to be laid between the Scarphs. All the Bolts to go through the Apron and well clenched thereon. The Rabbet to be taken out of the middle of the Stem, if required.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
APRON—*continued.*					
And broad as the Stem, if the Rabbet is in the middle; *otherwise*......	2 4	1 8	1 6	0 10	1 0
BOLLARD or KNIGHT-HEAD TIMBERS, to be square at Head . .	1 3½	1 2	0 11	0 10½	0 9
To be sided at the Heels	1 1	1 0	0 8½	0 8	0 9
*** *The Heads to cast or open for securing the Bowsprit; and the Heels to run low enough down to take a Bolt in the Hook next below the Gun-deck Hook.*					
To be coaked and bolted through the Apron with Bolts, in number	*four*	*three*	*two*	*two*	
and diameter	0 1¼	0 1⅛	0 0⅞	0 0¾	
HAWSE PIECES *—on each side, in Number	*four*	*three*	*three*	*four*	*two*
Foremost Hawse Piece, sided..................	1 6	1 3½	1 2	...	0 10
Second Hawse Piece, sided..................	1 5½	1 3½ (Second and Third)	1 4	0 9½	0 9
Third Hawse Piece, sided..................	1 5½				
Fourth Hawse Piece, sided..................	1 6	1 3½	1 2		
Holes in diameter, on a square, *after the Pipes are let out*...............	1 5	1 2½	0 10	0 8	0 5
To be in distance from each other on a square	1 6	1 1	0 11	0 10	
Hawse Pipes thick at the bottom	0 1½	0 1¼	0 1	0 0¾	
Each to weight about *cwt. qrs. lbs.*	8 0 0	3 0 0	2 2 0		
The Hawse Pieces bolted together, one bolt above the holes, and *number below*............	*two*	*two*	*two*	*one*	*one*

* The Hawse Pieces to fay against each other in wake of the Holes, and to be open above and below from one to two inches for air.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigates. GUNS 36		Merchant Ships. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
HAWSE PIECES—*continued.*										
The Bolts to be in diameter	0	$1\frac{1}{8}$	0	$1\frac{1}{8}$	0	$0\frac{3}{4}$	0	$0\frac{1}{4}$	0	$0\frac{1}{4}$
STERN POST.—Fore and Aft at the Head	1	8	1	6	0	10	0	10	0	7
Thwartships at the Head	1	8	1	6	1	1	0	11	0	9
Fore and Aft at the Wing Transom	1	8	1	6	1	2	0	11	0	11
Thwartships at the Wing Transom	1	8	1	6	1	$1\frac{1}{2}$	0	10	0	10
Fore and Aft at the Deck Transom	1	8								
Thwartships at the Deck Transom	1	8								
Thence to taper at the Keel to	1	3	1	1	0	10	0	$9\frac{1}{2}$	0	7
Fore and Aft on the Keel *(the back or false post included)*	3	0	2	7	3	2	1	9	1	8
And the main post not to have less wood abaft the rabbet in that direction	1	0	0	11	0	8	0	8	0	7
Aftside abaft the rabbet at the Wing Transom	1	1	0	10	0	11	0	9	0	8
Aftside of the rabbet abaft the After-timber expressed in the Dimensions										
At Wing Transom, at lower edge of Tuck rail	4	10	4	0	4	0	2	$2\frac{1}{2}$ *afore it*	1	3 *afore it*
Upper edge of Keel	1	4	1	6	0	6	0	3	1	4
False Post, the back of it *(if any)* to be abaft the rabbet on the Keel	2	3	1	9	2	8	1	5	1	4
INNER POST *—Fore and aft at the upper end	1	1	0	$9\frac{1}{2}$	0	8	0	7	0	6
Fore and aft on the Keel	1	4	1	2	0	11	0	9	0	8
To run up to the under side of Transom	*deck*		*wing*		*wing*		*deck*		*deck*	

* Broad, or Thwartships, as the Stern Post from the Lower Transom, upwards, and thence to the Keel, as the shape of the body may require. To have a tenon into the Keel as the Main Post.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigates. GUNS 36		Merchant Ships. TONS 330		Brig. TONS 170		Sloop. TONS 60.	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
INNER POST—*continued.*										
The heel of the Post to be secured with dove-tail plates	2	0	1	8	1	6	1	3	1	3
Broad or spread at the ends	0	7	0	6	0	$5\frac{1}{2}$	0	5	0	5
Broad in the middle	0	$5\frac{1}{2}$	0	5	0	$4\frac{1}{2}$	0	4	0	4
Let in flush with thin sheet copper behind, plates thick..................	0	$0\frac{5}{8}$	0	$0\frac{1}{2}$	0	$0\frac{1}{2}$	0	$0\frac{3}{8}$	0	$0\frac{3}{8}$
Countersunk Bolts in each plate, *in number*	*six*		*six*		*six*		*four*		*four*	
The Bolts to have proper heads, and *in diameter*	0	1	0	$0\frac{7}{8}$	0	$0\frac{3}{4}$	0	$0\frac{3}{4}$	0	$0\frac{3}{4}$
TRANSOMS.—WING TRANSOM:										
Height of the upper side of the Wing Transom at the middle line above the upper edge of the rabbet of the Keel........................	26	6	21	11	19	0	13	8	8	6
Depth of the margin	0	6	0	5	0	$3\frac{1}{2}$	0	3	0	$2\frac{1}{2}$
Round Aft of the Wing Transom	0	5	0	6	0	$5\frac{1}{2}$	0	5	0	3
Round down of the Wing Transom at the ends...	0	5	0	4	0	3	0	3	0	$2\frac{1}{2}$
Breadth at the Aftside of Wing Transom *, or its length at the Aftside ..	32	6	24	4	17	0	17	0	11	10
Sided	1	$1\frac{1}{2}$	1	$0\frac{1}{2}$	0	11	0	11	0	9
Moulded at the middle ..	2	0	1	10	1	4	1	$0\frac{1}{2}$	0	8
Moulded at the ends	1	6	1	4	1	1	0	$10\frac{1}{2}$	0	7
Bolted to the Post with two Bolts, *in diameter* .	0	$1\frac{1}{4}$	0	$1\frac{1}{8}$	0	$0\frac{7}{8}$	0	$0\frac{7}{8}$	0	$0\frac{3}{4}$
FILLING TRANSOM, Sided, *or so as to leave for air between it and the Wing Transom*......................	0	10	0	$10\frac{1}{2}$						
And, above the Plank of the Lower Deck........	0	$2\frac{1}{4}$	0	3						

* No chocks are admitted on the Aftside of the Wing Transom. Observe to place the Bolts clear of the middle. Merchant ships often have the underside wrought straight.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigates. GUNS 36		Merchant Ships. TONS. 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
FILLING TRANSOM—*continued.*										
Bolted to the Posts with two Bolts (*clear of middle*) *diameter*	0	1⅛	0	1	0	11				
DECK TRANSOM, Sided............	1	2	0	11½						
Moulded as broad as it possibly can be gotten, and rabbetted on the foreside for the better securing the Deck Plank, if a hook, to be long....................										
Chocks on the Aftside (if any) *not to exceed in thickness*	0	7	0	5						
Bolted thro' the Post, with two Bolts (*clear of middle*) *diameter*	0	1¼	0	1⅛	0	0⅞				
TRANSOMS below the Deck, or FILLING TRANSOMS, *in number*	*five*		*two*		*five*		*four*		*three*	
Sided — *The First*..........	0	11½	0	10½	0	8	0	9	0	7
Sided — *Second*	0	11½	0	10½	0	8	0	9	0	6
Sided — *Third*.........	0	11½	...		0	8	0	9	0	6
Sided — *Fourth*........	0	11½	...		0	8	0	9		
Sided — *Fifth*..........	0	11½	...		0	7				
Sided — *Sixth*..........	0	11½								
Bolted with one Bolt in each, clear of the Stern Knee Bolt, *diameter*....	0	1¼	0	1⅛	0	0⅞				
To leave space for air between each Transom...	0	3	0	4	0	4				
WING TRANSOM KNEES.—To have a Knee on each side, *sided if wood* *..........	1	0	0	10	0	7	0	5½	0	5
The Fore and Aft arm, in length	15	0	11	0	6	0	3	0	4	6
Thwartship arm, in length	6	9	6	0	4	6	4	0	3	6

* The Fore and Aft arm of the Wood Knees are to be coaked or wrought with a Hook and Butt in the upper strake of spirketting, and the Thwartship arm to coak or hook into the Transom Iron Knees. To have iron plates at the toe-holes.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Wing Transom Knees—*continued.*					
Bolted, with Bolts, in number.................	14	11	8	7	7
Bolts in diameter	0 1¼	0 1⅛	0 0⅞	0 0¾	0 0¾
To have two Bolts at each end, or lip, *diameter*...	0 0⅞	0 0¾	0 0⅝		
Iron Wing Transom Knees, each to weigh about *cwt*......		...	3 2 0		
Lower Deck Transom Knees, Sided	0 11	0 8½	0 6½		
Fore and Aft arm to cast under the Beams in length	9 0	8 0	6 0		
Thwartship arm in length, and coak into the Transom....................	5 6	4 9	3 9		
Bolted with Bolts *in number*	*ten*	*ten*	*seven*		
Middle Deck, *and diameter*........................	0 1¼	0 1⅛	0 0⅞		
Fashion pieces.—The After Fashion Piece to be sided.......	1 0½	1 0	0 8	0 8	0 7
After Fashion Piece to run up to the Underside of the	*third*	*next to wing*	*first*		
Middle Fashion Piece to run up to the Underside of the Deck	*deck*				
And the Heel to the Stepping upon Deadwood *Sided*	1 0½				
Foremost Fashion Piece to be Sided, *and to run up above the Wing Transom, or longer if to be gotten*	1 1	1 0½	0 9½		
	2 9	2 6	2 9		
and the Heel to run down below the Transoms....................	1 1	1 0			
The Fashion Pieces to face on upon the ends of the Transoms	0 1¼	0 1⅛	0 0¾		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
FASHION PIECES—*continued.* *** *The Fashion Pieces and After Timbers are to stand square, or nearly so, with the turn of the body.*					
ROOM and SPACE, or Timber and Room, to be...........	2 9	2 5	2 2	2 0	2 1$\frac{3}{16}$
FRAME TIMBERS. — *The First or Lower, Second or Middle, and Third Futtocks, and Top Timber, to be scarphed or framed together, and bolted with Bolts in each Scarph, in number*	*three*	*three*	*two*	*two*	*two*
The Bolts to be square iron, *diameter*	0 1$\frac{1}{4}$	0 1$\frac{1}{8}$	0 0$\frac{7}{8}$	0 0$\frac{3}{4}$	0 0$\frac{3}{4}$
Lower futtocks to be bolted to the Floors in the same manner.					
To have Two Short Timbers over each Port, sided	0 11				
and upper end sided...	0 10				
The Short Timber over the Upper Ports to be sided at the *Lower-end*	0 10	0 8			
Upper-end ...	0 9	0 7			
FLOOR TIMBERS.—In number......	48	43	35	29	18
And sided in the bearing of the ship	1 4	1 2	1 0	0 10	0 9$\frac{1}{2}$
Sided from the bearing of the ship to forward and aft	1 3	1 1	0 11	0 9$\frac{1}{2}$	0 8
And those quite forward and aft..................	1 2	0 11$\frac{1}{2}$	0 10	0 9	0 7
Length in the Mid-ships	25 6	21 0	19 0	16 0	11 0
Not to have less whole wood below the Cutting down in Mid-ships, and forward and aft to increase with the rising...	1 4	1 2	1 0	0 11$\frac{1}{2}$	0 8$\frac{1}{2}$

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	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
FLOOR TIMBERS—*continued.*										
To be moulded at the heads *	1	1½	0	11	0	8½	0	9½	0	6½
LOWER or FIRST FUTTOCKS.—To be sided along Midships	1	3½	1	1½	0	10½	0	10	0	7½
Ditto afore and abaft	1	2¼	1	0	0	9½	0	9½	0	7½
To be moulded at the Heads	1	1	0	10½	0	7¾	0	8	0	5¾
To scarph on the Second or Middle Futtocks in Mid-ships	7	0	6	3	5	10	4	6	3	6
Ditto afore and abaft	6	6	5	6	5	0	4	2	3	3
The Heels of the Futtocks to run down to Dead-wood, and to have substance left there.........	0	6	0	4						
Not to have less stepping or substance at the Heels of the Double Futtocks, and Half Timbers, and	0	3½	0	3	0	2	0	1½	0	1½
the Heels bolted, with bolts, in diameter	0	1⅛	0	1	0	0¾	0	0¾	0	0¾
SECOND or MIDDLE FUTTOCKS.—Sided along the Midships	1	2	1	0½	0	9¾	0	9	0	7
D° Afore and Abaft......	1	1½	1	0	0	9	0	8½	0	7
To be moulded at the Heads	1	1	0	9¾	0	7¼	0	7½	0	5
To scarph on the Third Futtocks amidships	7	0	6	3	5	10	5	6	4	0
D° Afore and Abaft......	6	0	5	9	5	0	4	9	3	3
THIRD FUTTOCKS.—To be sided along the Midships....	1	2	0	11½						
D° Afore and Abaft......	1	1½	0	10¾						
To be moulded at the Heads	1	0½	0	9½						
To scarph on the Fourth Futtocks or Top timbers in Midships	7	0	6	3						
D° Afore and Abaft......	6	0	5	9						

* The Bolts through the Floors are of the same size as the Kelson Bolts. In King's ships the openings are filled up and caulked to the Floor Heads.

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	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
THIRD FUTTOCKS—*continued.*										
⁂ *Those that come under Gun Deck Ports are to run up to the Sills.—In small vessels, where they make the sides of Ports, they must be sided half an inch more, and run up to the topside, and in wake of the Channels.*										
FOURTH OR UPPER FUTTOCKS.—To be sided	1	1½	0	11	0	9	0	8	0	6½
To be moulded, at the Middle Deck	...		...		0	8½				
D° at the Upper Deck	0	10½	0	8	0	7½	0	7	0	5
To scarph on to the Top-timbers in Midships	12	0	10	9	6	0				
D° Afore and Abaft	9	9	7	9	4	9				
⁂ *Upper Futtocks in merchant ships are to run up six inches above the Middle Deck, all Fore and Aft, except those that make the sides of Ports, which are to run up to the top of the side (if to be had). Those under the Ports to run up to the Sills.*										
TOP TIMBERS*.—To be sided at the Heels	1	1	0	10½	0	9	0	8	0	6½
Sided at the Upper Futtock Heads, or in wake of the Ports	1	1	0	10½	0	9				
Sided at the top of the side	1	0	0	10	0	7½	0	7	0	6
Moulded.—*In the range of the Lower Ports or Upper Deck Ports in Frigates, and at the*										

* Top-timbers making the sides of Ports are sided half an inch more than the above, that they may not be too much weakened by letting in the Sills; and have short Top-timbers to run up to take the rough-tree rail, &c.

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
TOP TIMBERS—*continued.*					
Middle Deck in Merchant Ships	1 0	0 8¼	0 6¼		
In the range of the Quarter Deck	0 7	0 6			
In the range of the Forecastle	0 7	0 6			
In the waist at the top of the side	0 6½	0 5½	0 4¼	0 5½	0 3½
COUNTER TIMBERS. See STERN.					
KELSONS. In number	*one*	*one*	*one*	*one*	*one*
KELSONS. To be square (exclusive of what it lets down	1 5	1 2½	1 0	0 11	0 9
Between the Floors, which may be.................	0 1	0 1	0 0⅞	0 0¾	0 0¼
Number of Pieces	*six*	*six*	*four*	*three*	*two*
The scarphs in length *(the middle to come on a floor)*	5 6	4 9	4 0	3 9	3 6
Lips of the Scarphs not more in thickness than	0 5	0 4¾	0 3	0 2	0 2
STEMSON, or Inner Stem, to be sided at the upper end,	1 1	0 10½	0 8½	0 10	
and moulded	1 1	0 10½	0 7	0 8	
And scarph on to the foremost piece of Kelson...	4 6	3 9	3 0	2 9	
And to run up to the upper side of Deck Transom	*upper*	*upper*	*upper*	*upper*	
MAIN WALES.—Height of the Lower edge					
At the Stem	22 6	19 0	16 10	11 9	7 3
At Dead Flat	18 9	16 6	13 3	9 9½	5 11
At the After Timber	23 9	20 3	17 0	12 6	7 8
*** *These heights are taken in a line with the upper edge of the rabbet in the Keel.*					
Main Wales broad	4 3	3 9	3 4	2 0	1 4
Number of Strakes	*four*	*four*	*four*	*three*	*two*
and thickness...	0 8	0 6	0 4½	0 5	0 4
THICKSTUFF under Main Wales.— *Strakes in number*	*eight*	*six*	*three*	*two*	*two*

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	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
THICKSTUFF—*continued.*										
The upper edge of the first to be thick	0	8	0	6	0	4	0	3	0	3
The upper edge of the lower strake, thick	0	5¼	0	4¼	0	3¼	0	2¼	0	2¼
*** *The under edge to be of the thickness of the bottom plank, and the intermediate strakes to taper regularly thence to the upper edge of the upper strake.*										
Number of strakes of English plank under the wale	*nine*		*seven*		*seven*		*five*		*four*	
PLANK of the BOTTOM to be thick *	0	4	0	4	0	3	0	2½	0	2
And to have three strakes between every two butts, and scarphs in length	6	0	6	0	5	0				
To fasten the bottom plank with treenail, size when mooted, (and should not be overhauled afterwards)	0	1¼	0	1¼	0	1¼	0	1	0	1
To have one bolt in the timber next each butt and clenched inside, *diameter*	0	1	0	0⅞	0	0¾	0	0⅝	0	0⅝
THICKSTUFF upon the Main Wales.—Strakes, *in number*...	*two*		*two*		*two*		*one*		*one*	
The first strake upon the wale............ *thick*....	0	7	0	5	0	3½	0	3½	0	3
broad...	1	1½	0	11	0	11	0	9	0	8
The second strake upon the wale ....*thick*....	0	6	0	4	0	3				
broad...	1	0	0	10	0	10				
Stuff of Topside, *to dimi-*										

* Owing to the scarcity of Oak plank, it is admitted, particularly in merchant ships, to work 2½ and 3-inch plank, with six feet shift, and two strakes between; and 4-inch plank, and upwards, with five feet shift, and three between every two butts upon the same timber.

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
THICKSTUFF—*continued.*					
nish from thick stuff upon the wales to under edge of sheer strakes	...	...	0 2½	0 2	0 1½
CHANNEL WALES.—Distance from the upper edge of the Main Wales in Midships to the lower edge of the Channel Wale on a perpendicular	4 5				
Channel Wale broad	3 0				
Number of Strakes	*three*				
Thickness	0 5				
Plank above the Channel Wales.—*The lower edge of the first Strake upon the Channel Wales to be thick*	0 4				
The second Strake above to be thick..................	0 3				
SHEER STRAKES.—Distance on a perpendicular from the upper edge of the Channel Wales (in two deck ships) and main Wales (in Frigates, &c. &c.) to the Top-timber line or upperside of the Sheer Strakes	5 4	6 9			
Sheer Strakes broad	2 2	1 11			
Number of Strakes	*two*	*two*			
and thick	0 4	0 4			
*** *The lower edge of the Sheer Strakes works down to the Ports of the Upper Deck along the Midships—To be of English Oak Plank behind the Channels.—The Sheer Strakes to be kept parallel Fore and Aft.*					
Plank upon the first drift to be thick	0 3	0 2½	0 2		

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
SHEER STRAKES—*continued.*					
Plank next under the Plank Sheers, upper edge thick	0 2¼	0 2	0 2		
BUTT END BOLTS.—To have one Bolt driven with a ring under its head (or a full head made) in the timber next the butt of the Wales. Clamps, and all stuff, four inches thick: the bolts the size of those in the butts of the bottom.					
WITHIN BOARD.					
ORLOP CLAMPS.–Strakes, in number	*two*	*two*			
The upper Strake *thick*...	0 7	0 5			
broad..	1 3	1 1			
The lower Strake *thick*...	0 6	0 4			
broad..	1 1	0 11			
The said two Strakes may be reduced to one at the fashion piece and apron, and reduced in thickness within 7 or 9 feet to	0 5	0 3			
and broad	0 10	0 10			
ORLOP BEAMS.—The upper sides to be below the under side of the gun-deck plank at the middle of the beam ......*Afore*...	7 2				
Midships	7 2	5 2			
Abaft ...	7 2				
Beams to round up in Midships	0 2¼	0 2			
To have Beams in number	22	*six*			
Aftside of the after beam					

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*
ORLOP BEAMS—*continued.* afore the after perpendicular	24 3				
Orlop Beams to be square	1 3	0 10			
*** *Those Beams which are made in two or more pieces are put together and bolted as the Gun-deck beams, which see.*					
KNEES.—*The Orlop beams to be kneed at each end, with one Lodging Knee, fayed home to the Timbers, excepting to those beams that come upon the inside stuff, there the Knees to fay also.*					
Lodging Knees—to be sided	0 9¼	0 7½			
Thwartship Arm long (*coak into the beam*) ...	4 6	3 7			
Fore and Aft Arm from beam to beam, or not short of.................	4 6	4 0			
Standard Knees, to have one Standard Knee to each end of every beam, except those beams where there comes second futtock riders and the beams from afore and abaft	*three*				
Standard Knees to be sided	0 9½	0 8			
Thwartship Arms long ...	4 3	3 7			
The side arms to reach upwards from the underside of the Orlop beams to the underside of the Gun-deck beams within two inches.					
The Knees to be bolted with *bolts, in number* ...	8 *or* 9	8 *or* 9			

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	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
KNEES—*continued.*					
The knees to be bolted with bolts, in *diameter*	0 1¼	0 1¼			
*** *To have four bolts in the beam arms and five bolts in the side arms, where the length will admit.*					
CARLING.—To frame the Orlop on each side, *No. of tiers* .	*three*	*three*			
From the room before the Fore Hatchway to the room of the Mizen-mast, and from thence forward and aft ...*tiers*	*two*	*two*			
Carlings .. { ....*broad*	0 9	0 7			
Carlings .. { ....*deep*	0 8	0 6			
——— scored on upon the beams aloft.........	0 1½	0 1⅛			
and below	0 1¼	0 1			
The side tier of Carlings to be kept out clear of the side.................	3 6	3 4			
LEDGES.—The Ledges to be *broad*	0 5½	0 5			
deep	0 5	0 4½			
asunder	1 0	1 0			
PLANK or BOARD, for the Orlop flat, *thick*.....................	0 2	0 1½			
STRAKE upon the ends of the Orlop beams *thick*	0 6	0 4			
and *broad*	1 2	1 0			
PLANK above this strake to the Gun-deck clamps to be *thick*	0 4½	0 3			
STEP for the Fore Jear-capstan, *broad*	1 10				
Depth to answer with the Capstan-partners aloft.					
To be let down with a double stop, and on the beam aloft	0 2⅛				
And the ends to be bolted through the beams with two bolts in diameter	0 1⅛				
STANTIONS.—To have a tier next					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
STANTIONS—*continued.* the side, and at each end of the Orlop, to stop the crowns of the cables, *sided*	0 8	0 6½			
To be Fore and Aft	0 7	0 6			
The said Stantions to be kept clear of the side...	3 6	3 4			
*** *The Flat within the Wings to be framed with ledges 3 inches square, let down into the side Carlings and Knees.*					
IN THE HOLD.					
LIMBER BOARDS to be thick (of English oak plank) and fitted into rabbets to lie flush	0 3	0 3	0 2½	0 2	0 2
Strake next the Limbers, or upon the lower futtock Heels, *out from the side of the Kelson*	0 11	0 11			
The Limber boards not to exceed 3 feet long, and those under the hatchways to be fitted with the grain upwards					
Number of thick Strakes next the Limbers	*two*	*two*	*one*	*one*	*one*
The first *thick* or Limber Strake	0 8	0 6	0 4	0 4	0 3
broad..................	1 2	1 11	1 0	0 10½	0 9
The second to be *thick*...	0 7	Wrought top and butt.	0 3	0 3	0 2
broad...	1 1		0 10	0 9	0 8
Which Strakes may be reduced to one afore and abaft, and in thickness (within about 9 feet of the extreme)	0 5½	0 4	0 2	0 1½	0 1½

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigates. GUNS 36		Merchant Ships. TONS 330		Brig. TONS 170		Sloop. TONS 70	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
THICKSTUFF at the FLOOR-HEADS, *number of Strakes*.......	*five*		*six*		*three*		*three*		*two*	
The middle Strakes, or Strake, that is wrought on the joints of the floor-head, to be *thick*	0	8	0	6	0	4	0	3½	0	3
broad	1	3	1	10	1	0	0	9	0	8
And the Strake, or Strakes, above and below those on the joints, to be *thick*	0	8	0	5	0	3	0	2	0	2
broad	1	1	1	10	0	9	0	8	0	7
And the upper and lower Strake........... *thick*...	0	7	Two Strakes, each wrought Top and Butt.							
broad...	1	0								
Which number of Strakes is to be reduced afore and abaft to............	*four*		*four*		*two*		*one*		*one*	
And in thickness (*within about* 9 *feet of the extreme*)	0	5	0	3	0	2	0	1½	0	1½
THICKSTUFF at the First Futtock Heads, or Middle Bands, in Merchant Ships, *number of Strakes*	*three*		*four*		*two*					
The middle Strake, or Strakes, wrought on the joint, to be......*thick*...	0	7	0	5	0	4				
broad...	1	3	2	0	1	0				
And the Strakes, or Strake, above, below those over the joints, to be...*thick*	0	6	0	4						
broad	1	1	1	8						
Which number of Strakes forward and aft may be reduced to	*two*		*three*		*two*					
And in thickness (*within about eight feet of the extreme*	0	4	0	3	0	2				
FOOTWALING between the Thickstuff.—The Footwaling between the Limbers and Floorheads—*thick*	0	5	0	4	0	3	0	2½	0	2
The Footwaling between										

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
FOOTWALING—*continued.* the Floor-heads, and First Futtock heads, *thick*....................	0 4	0 3			
The Footwaling above the Thickstuff at the Floor-heads and Middle Bands to be in thickness...............	...	...	0 3	0 2½	0 1½
LOWER DECK TRANSOM KNEES, and TRANSOM KNEES.—See TRANSOMS.					
SLEEPERS or POINTERS.—On each side.........*Number*....	*three*	*two*	*two*		
Sided.......	0 10½	0 9½	..		
Arm next the side long....	12 0	9 6			
Those made of iron to weigh about...........	...	...	2 3 0		
Bolts in number in the Fore and aft or Side Arm.....................	*seven*	*six*	*five*		
and diameter	0 1¼	0 1⅛	0 1		

*** The Arms that fay against the Transoms are to stand square thereto, and to take two bolts through as many Transoms as possible. The heads of the Sleepers to run up to the upper side of the Deck Transom, in larger ships, and Wing Transom in frigates. The foremost to clear the toe of the Deck or Wing Transom Knee. Of that next the middle line, the head fays against the Sternson Knee in large ships, at the next Transom below the Deck, and the middle one equally between.

CRUTCHES.—In the Run Abaft... *Number*...	*three*	*three*	*two*	*two*	*one*
Sided......	1 1	0 10	...	0 7½	0 6½
Length of the Arms each	8 0	6 0	6 0	5 9	4 9
Bolts, in *number*..........	*twelve*	*eight*	*eight*	*six*	*six*
Diameter...........	0 1¼	0 1⅛	0 1	0 0¾	0 0¾
MAIN STEP.—The Main Step to be sided................	3 0	2 6	1 9	1 6	1 4
Deep upon the Kelson...	1 5	1 2	1 0	0 10	0 10
In length (or to slide easily by the Well Stantions)	...	...	4 9	4 0	4 0
FORE STEP.—Fore step made in					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigates. GUNS 36		Merchant Ships. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
FORE STEP—*continued.* one, to be sided (and the middle placed under the centre of the mast)	2	3	2	1	1	6	1	3		
Length....................	11	6	10	9	8	0	6	0		
BREAST-HOOKS.—To have Breast-hooks equally spaced between the Fore Step and Lower Deck Hook, *in number*	*four*		*three*		*three*		*three*		*two*	
The Upper Breast-hook in length	16	0	15	0	12	0	10	8	9	0
The Lower Breast-hook in length	12	0	12	0	10	0	9	6	9	0
Each sided...	1	3	0	11	0	9	0	8½	0	7
Bolts in number in the *Upper Hook* ...	13		11		9		7		7	
Lower Hook ...	11		9		7		7		7	
in diameter ...	0	1⅜	0	1¼	0	1	0	0¾	0	0¾
The Breast-hooks to stand square with the body as nearly as possible.										
FLOOR RIDERS.—To have Floor Riders ....*in number* ...	*four*									
in length	24	0								
Sided	1	5								
Deep on the Kelson, not less than	1	4								
Moulded at the Floor Head on the thickest Strake..................	1	2								
Bolts in each, *in number*	10									
diameter......	0	1⅜								
LOWER FUTTOCK RIDERS, sided ...	1	3								
Number on each side	*six*									
Moulded at the Floor Heads on the thickest Strakes..................	1	3								
Moulded at the Heads...	1	0								
The lower Ends not to reach the Kelson by ...	2	0								
And not to leave less										

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigates. GUNS 36	Merchant Ships. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
RIDERS—*continued.*					
whole wood at the ends than	0 4				
The Heads to reach upwards, to give scarph to second Futtock Riders	8 3				
Such as fay to the sides of the Floor Riders to be *in number*	*two*				
Bolted thereto fore and aft with square iron, *diameter*	0 1⅜				
To have Cross-chocks fayed with a Hook, and *deep on the Kelson*	1 4				
Butt Scarphs across the Heels of the lower Riders, *Scarphs, long*	4 3				
Bolts through the Cross-chocks, *in number*	*six*				
diameter	0 1⅜				
Fore and Aft Bolts through the Crosschocks and Floor Riders, square iron *number*	*six*				
diameter....	0 1¼				
SECOND FUTTOCK RIDERS.—On each side, *number*	*six*				
sided	1 2				
Length sufficient to scarph under the head of the Floor Rider, and to continue upwards to the lower side of the Orlop Beams.					
The Scarphs to have a Hook Butt, and length	3 0				
The Scarphs to have a Hook Butt, and *moulded*	1 2				
Bolted with Bolts in *number*	*seven*				
diameter ...	0 1⅜				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigates. GUNS 36		Merchant Ships. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
THIRD FUTTOCK RIDERS.—On each side, *Number*	*six*									
Sided	1	2								
Bolted with Bolts, in *Number*	6 *or* 7									
Diameter	0	1¼								
Moulded	1	2								
PILLARS in the HOLD.—To be square *Heel*	1	1	0	8½	0	6½	0	6	0	6
Head	1	0	0	7½	0	5½	0	5	0	5
WELL.—The well to be fore and aft in the clear	10	0	7	9	5	0	2	0		
Thwartships	8	3	6	9	4	9	4	6		
The sides to be English oak plank cyphered and thick	0	3	0	3	0	2	0	1½		
Stantions square	0	7	0	6						
FORE MAGAZINE.—Bulkheads to be of English oak plank rabbetted and thick	0	3	0	3						
Stantions (to be on the foreside of the bulk-head) English oak, square	0	6½	0	6						
Stantions of the bulk-head in the clear asunder	2	9	2	7						
Height from the upper-side of the magazine flat to the underside of the flat above	8	9	6	0						
Length of the Magazine Flat or Platform	12	0	12	0						
Magazine Platform Beams to be English Oak, square	0	8½	0	7						
Asunder in the clear (to have a Scuttle in the middle)	2	4	2	2						
The Flat to be English Oak Plank, thick (and caulked)	0	3	0	2½						

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS. 330	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
FORE MAGAZINE—*continued.* Upon the Magazine Platform to have palleting Beams of Fir, *square*	0 7	0 7	Fastened with tree-		

nails directly over the Platform Beams. To have Rabbets of 1½ inch grooved out of the upper edges. Into the palleting Beams are let down Fir Carlings, the same size as the Beams, with Rabbets in their edges, corresponding to those in the Beams; the middle tiers to be equally spaced from the middle line, and parallel thereto, to the distance the palleting Beams are apart; but into the sides to contract the size as the shape of the body may require.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS. 330	Sloop. TONS 60
FILLING ROOM.—To make a Filling-room before the Magazine under the Lights.					
Filling room, *in length* ...	7 0				
Beams for the Flat, *in number*	*two*	*two*			
square	0 7½	0 7			
Filling-room, *broad*	4 4	4 0			
and deep ...	1 0	0 11			
AFTER MAGAZINE.—The Magazine in small ships and POWDER ROOM in large ships, is generally aft. It is built at the aft side of the After-beam of the After-platform, next afore the Bread-room, complete with racks, and parted off to hold barrels similar to the Magazine forward.					
Distance in the clear between the bulkheads	10 6	7 3			
Height from the platform to the deck above......	8 6	9 0			
Athwartships in the clear	12 6	10 0			
Beams of the platform (oak) .... *square*...	0 7	0 6			
Flat deal (caulked) *thick*	0 2	0 2			

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
AFTER MAGAZINE—*continued.*										
Bulkheads plank or deal rabbeted ...... *thick*...	0	3	0	2½						
Stantions of oak, *square*	0	6	0	5						
asunder	2	9	2	6						
GUN or LOWER DECK.— Height of gun or lower deck Clamps. See BEAMS.										
CLAMPS composed of Strakes, *in number*	*four*		*two*		*one*		*one*			
Upper Strake .... *thick*...	0	8	0	5	0	4	0	4		
broad...	...		2	0	1	1	0	11		
Second Strake.... *thick*...	2	8	...							
broad...	...		...							
Third strake...... *thick*...	0	7								
broad...	1	2								
The number of strakes is reduced one less forward and aft, and thickness to	0	5	0	3	0	3				
Preserving their proper thickness from the extremes	9	0	9	0	7	0				
STUFF between the Lower-deck clamps and Orlop *thick*	0	5	0	4	0	3				
Opening between for air *deep*...	0	4	0	4						
DECK HOOK—To be *sided*	1	2	1	0	0	10	0	9		
length	19	0	16	0	13	0	12	0		
Bolted with bolts, in *number*	13		11		9		9			
diameter	0	1⅛	0	1⅛	0	1	0	1		
BEAMS.—Height of the upperside of the Gun or Lower deck plank, at the middle line from the upper edge of the rabbet of the Keel .... *afore*...	24	6	16	8	15	0	12	7		
midships	22	6	15	9	14	0	11	3		
abaft...	24	6	17	11	15	9	13	8		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
BEAMS—*continued.*										
Lower-deck plank...*thick*	0	4	0	3	0	2½	0	2½		
Height from the upperside of the Gun or Lower-deck plank to the underside of the deck plank above at middle line ... *afore* ...	7	2	6	2	6	1	4	10		
midships	7	2	6	2	6	1	4	10		
abaft ...	7	2	6	2	6	1	6	6		
Beams to round up in midships	0	6	0	4½	0	4	0	6		
Height from the upperside of the deck plank to the upperside of the lower sills	2	4								
Port Sills, *Lower sills, deep*	0	7½								
Upper sills, deep	0	6								
Ports—*deep*	2	9								
Fore and aft	3	5								
Foreside of the foremost port, abaft the foremost perpendicular	18	3								
Aftside of the afterport, afore the after perpendicular	10	8								
In distance from port to port	7	6								
Beams—*To be Sided*	1	4	0	10	1	0	0	11		
moulded	1	4	0	10	0	11¼	0	8		
Beams, *in number*	27		26		19					
Asunder about	...		...		4	7				
Beam in the Main Hatch, to have double arms, and in wake of the Fore Mast single arm *deep*	1	3	0	9	0	9½				
moulded .	1	2	0	10½	0	10				
The arms to be scarphed and tabled. *Scarphs long*	9	6	7	6	6	9				
Bolts in each arm, *in number*	*eight*		*six*		*six*					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
BEAMS—*continued.*					
Square iron, *diameter*	0 $1\frac{1}{8}$	0 1	0 $0\frac{3}{4}$		

KNEES.—The gun or lower deck beams to be knee'd at each end, with one Hanging and one Lodging Knee. Sloops of 18 guns, and under, have Hanging and Lodging Knees only to the first and second beam afore and abaft the Main Mast, and Fore Hatchway Beams; the beams knee'd with Lodging Knees only. Merchant Ships have Iron Hanging Knees, or Dagger Knees, if of wood, sometimes about 12 beams in Midships have hanging Knees.

Hanging Knees...*Sided*...	0 11	0 $8\frac{1}{4}$	0 6	0 6	
Hanging Arms . . *length* .	6 2	4 9	3 9	3 6	
Thwartship Arms *length* .	4 6	3 8	3 3	3 0	
Bolts, *in number*	*nine*	*eight*	*six*	*six*	
diameter	0 $1\frac{3}{8}$	0 $1\frac{1}{8}$	0 1	0 1	
If Iron Hanging Knees, each to weigh about *cwt.*	3 3 0	2 1 0	1 3 0		
LODGING KNEES.—The Lodging Knees, *sided*	0 10	0 $7\frac{1}{2}$	0 $5\frac{1}{2}$		
Thwartship Arm, *in length*	5 2	4 0	3 6		
Fore and aft to be the whole length between the beams, if to be had, or length sufficient for not less than bolts, *in number*	*four*	*three*	*three*		
Each Lodging Knee to have bolts, or more, *in number*	*eight*	*seven*	*six*		
and diameter .	0 $1\frac{3}{8}$	0 $1\frac{1}{8}$	0 1		

Lodging and Dagger Knees to have a coak left in the end of $1\frac{1}{4}$ inch long, with the long grain, or a tail when the grain will not admit of a coak. This coak, or tail, is to be closely fayed to the side of the beam, and an iron key driven by the sides. Beam arm to have a coping let into the beam.

CENTRES OF MASTS.—The centre of the Foremast abaft the foremost perpendicular	19 6	15 10	17 0	11 9	
Rake aft, in every yard in the length...............	0 $0\frac{1}{8}$	0 $0\frac{1}{16}$			
The centre of the Main Mast abaft the foremost perpendicular	99 6	77 0	59 9	46 6	19 10

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
CENTRES OF MASTS—*continued.*										
Rake aft in every yard ...	0	1	0	0⅝	...		0	0¼	0	1
The centre of the Mizen Mast afore the after perpendicular	27	3	20	9	14	9				
Rake aft, in every yard in the length	0	1	0	1	0	1				
Bowsprits to stive upwards, in a yard in length	1	4	1	3	1	6	1	0	0	5
MAST PARTNERS—To have two Carlings for the partners of the Main-mast *broad*	1	6	1	3	3	0	0	8		
deep .	1	5	1	2	0	4	0	10		
Asunder in the clear equally from the middle line	4	0	3	4	...		2	4		
Uppersides above the beam	0	9	0	6½	...		0	4		
Foremast Partners—Of two Carlings .....*broad*	1	4	1	1	2	9	0	8		
deep	0	10	1	0	0	4	0	10		
Let down below the upperside of the beam ...	0	1¼	0	1	0	1	...		0	1
Foremast Partners, *asunder in the clear*	3	10	3	0						
Fore and Main-mast Carlings bolted with bolts in diameter	0	1⅛	0	1	0	0¾				
MIZEN PARTNERS.—To be *thick*...	0	6½	0	5	0	3	0	3		
broad ...	3	10	3	6	2	9	2	4		
Let down upon the beams	0	1	0	1	0	0⅝	0	0⅝		
MIZEN STEP (the laps to extend to the farther side of the beams).................										
to be sided	1	8	1	7	1	1				
deep......	1	6	1	6	1	0				
BOWSPRIT STEP.—To be in *number of pieces*	*2 or 3*		*two*		*two*					
thick....	1	1	0	10	0	8	Made by the bitts upon deck.			
Outtooutside—in *breadth*	4	2	3	6	3	4				
Rabbetted together, and bolted athwartship with three bolts, *diameter*...	0	1¼	0	1⅛	0	0¾				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
BOWSPRIT STEP—*continued.*										
To extend from the underside of the beam at the lower end to upperside of beam above.										
Bolts thro' beam, *diameter*	0	$1\frac{1}{3}$	0	1	0	$0\frac{3}{4}$	Made by the bitts upon deck.			
to be let aft	0	$2\frac{1}{2}$	0	2	0	$1\frac{1}{4}$				
HATCHWAYS.—The Main Hatchway ......*fore and aft*	8	6	7	6	7	4	7	6		
thwartships	6	4	5	6	5	4	7	0		
Aftside, afore the centre of the main-mast	6	0	4	0	3	2	4	7		
Fore Hatchway, *fore and aft*	4	9	4	8	4	6	4	0		
thwartships	4	9	4	6	4	4	4	4		
Foreside of it abaft the centre of the foremast..	32	3	26	0	...		9	10		
After Hatchway										
fore and aft	4	8	4	8	...		2	9		
thwartships	4	8	4	3	...		3	8		
HATCHWAYS.—Fore side of it abaft the centre of the Main Mast	6	6	4	3	...		2	10		
CARLINGS.—Number of tiers on each side ....*from*	*three*		*three*		*two*		*two*			
to...	*two*		*two*		*one*		*one*			
Carlings to be oak, for frigates and small vessels may be fir ......*broad..*	0	9	0	7	0	6	0	6		
deep...	0	$8\frac{1}{2}$	0	$6\frac{1}{2}$	0	5	0	5		
Scored on upon the beams aloft, and ¼ of an inch less allow	0	$1\frac{1}{2}$	0	$1\frac{1}{4}$	0	1	0	$0\frac{7}{8}$		
LEDGES.—In the clear asunder not more than 12 inches, nor less than 9 inches...										
broad	0	$5\frac{1}{2}$	0	4	0	4				
deep.	0	5	0	$3\frac{1}{2}$	0	3				
COAMINGS.—To have coamings to the hatch and ladderways in 1 whole length, and bearded from the deck upwards.										

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
COAMINGS—*continued.*					
upperside above the deck	1 6	0 4	0 3		
broad upon the beam	0 8	0 7	0 5		
upon the upper side	0 7				
HEAD-LEDGES.—To be thick	0 7				
Deep as the coamings at the sides, and round up more than the beam in its length	0 2½				

The coamings and head-ledges to be lapp'd together at the ends so as to strengthen each way, and the coamings tailed ¾ of an inch into the head-ledges, and above the rabbets about ⅜ of an inch. N. B. The rabbet for the gratings must be taken out first.

The head-ledges to be bolted through the beams in the middle, and the coamings at the laps with bolts, *in diameter*	0 1	0 0¾			
RIDING BITTS.—The Riding Bitts are fixed upon the gun-deck of three and two-decked ships, upon the upper deck of frigates and under, and upon the middle deck of some merchant ships.					
Number of pairs	*two*	*two*			
Heads. Foremost ones—*square*	1 5	1 3			
After ones—*square*	1 5	1 4			
And to continue that size downwards below the beam next their heads	1 0	1 0			
And to taper thence, so as to be at the lower ends	1 2	0 10			
The heads above the deck	5 2	5 0			
The after-bitts, abaft the foreside of the forebitts	3 10	3 5			
Distance beween the after-bitts athwartships	4 6	5 0			

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
RIDING BITTS—*continued.*										
Each of the bitts to face on upon the aftside of beam	0	2½	0	1¾						
Each bolted to the beam, with two bolts *in diameter*	0	1⅛	0	1						
CROSS PIECES to the Bitts, *fore and aft*...	1	5	1	3						
deep..........	1	3	1	2						
To have elm backs, *in thickness*	0	6	0	5						
The underside of the cross-piece to the fore-bitts above the deck ...	1	9	1	6						
The underside of the cross-piece to the after-bitts above the deck ...	1	8	1	7						
Ends of the cross-piece to extend without the bitts	2	3	2	8						
Each scored on to the bitts with a facing of.........	0	2½	0	2						
STANDARDS or SPURS against the Bitts. The foremost standards to extend to the beam before the foremast, and cut with a swell on the midship side, to make the foremast partners. Standards to the after bitts continue forward to the aftside of the fore bitts *Sided*	1	0	0	11						
Let down upon the beams	0	1½	0	1¼						
Bolted through the beams and carlings, bolts *diameter*	0	1¼	0	1⅛						
To cut holes near the deck through the aft part of each spur, *diameter*	0	4	0	3½						
The upper part of the arms next the bitts to reach as high as the up-										

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
STANDARDS—*continued.* perside of the cross-piece.					
PARTNERS and STEPS of the CAPSTANS.—To frame partners for the fore jear capstan, that it may occasionally be lowered upon the Orlop.					
The framing to be carlings............*broad*...	0 10				
deep....	0 11				
Partners ....*thick*....	0 7				
STEP for the MAIN JEAR CAPSTAN *broad*....	1 9				
deep	1 8				
Upperside to stand above the beam	0 8				
Bolted through the beams, bolts *in diameter*	0 1¼				
HELM PORT TRANSOM ......*deep*...	0 10				
To the Helm Port Transom ....*sided*...	0 9				
KNEES.—Fore and aft arm long ...	10 6				
Thwartship Arm, long, (*to coak into the transom*)	5 8				
Bolts.					
In the fore and aft Arm number	*six*				
In the Thwartship Arm number	*four*				
in diameter	0 1¼				
WATERWAYS. — The Waterways *thick*.....	0 6	0 4	0 3	0 3	
FLAT of the DECK............*thick*...	0 4	0 3	0 2	0 2	
Number of strakes of English oak plank next the waterways	*five*	...	*one*	*one*	

To shut in between the headledges in midships, with oak one inch thicker than the deck-flat, and rounded to that size at the coamings.

The remaining part of the deck is laid with English oak, or the best East-country plank, if a Gun-deck, or with Prussian deal not more than ten inches broad, clear of sap.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
SPIRKETING.—Number of strakes on each side	*2 or 3*	*two*	*1 or 2*	*1 or 2*	
From the waterways to the upperside of the sills, or ......*in breadth*	...	2 0	1 6	1 6	
Thickness......*Lower edge*	0 7	0 5	0 3	0 3	
Upper edge	0 6	0 4½	0 3	0 3	
To have a bolt clenched inside, through every butt in the next timber *diameter*....	0 1	0 0⅞	0 0¼	0 0¼	
STUFF—Between the ports in *thickness*	0 4	0 3	0 2½	0 2	
Upon the spirketting and under the clamps, *thickness*...	0 3	0 3	0 2½	0 2	
HAWSE HOOK.—Under the holes or hooks between decks *sided* ...	1 2	0 11½			
Placed half the siding below the holes, and in *length*	19 0	17 0	13 0		
Fayed upon the stuff, and bolted with bolts in *number*...	13	11	0 8		
diameter .	0 1⅜	0 1¼	0 1⅛		
BREADTH RIDERS.—Number on each side	12				
sided	1 1				
moulded	1 0				

The said riders to stand as diagonally as the beams, &c. will admit.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
Bolted with bolts, *in number* ...	11				
diameter ...	0 1¼				
PILLARS.—One under each beam between decks to be neatly turned and square *upper end* ...	0 8	0 7	0 5½	0 5	
lower end...	0 9	0 8	0 6½	0 6	
STANDARDS OR RIDERS.— On each side, in *number*	*twelve*	*eight*	...	*three*	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
STANDARDS OR RIDERS—*continued.*					
If wood to be well grown and *sided*	1 0	0 10			
Wood or iron standards in the navy are to fay upon shoals of English plank 4 to 3 inches thick...........................				0 8	
If iron (in the officers cabins) in *weight* each ...	4 0 0	2 3 0	1 2 0		
Thwartship arms, *long* ...	4 7	3 7	3 6	3 2	
Bolts ....*in number*	*nine*	*eight*	*seven*	*six*	
diameter .	0 1⅜	0 1¼	0 1	0 1	
SCUPPERS.—To be of lead on each side, *in the manger*	*two*	*one*			
diameter in the clear ...	0 5	0 5			
To have on each side lead scuppers, *in number* ...	*six*	*three*			
Pumpdale scuppers, one on each side, *diameter in the clear* ...	0 7				
To have broad flaps on the inside, and the said flaps let into the spirketting to receive the end of the pumpdale.					
Pipes in the rooms.					
Diameter of the scuppers along the sides	0 4	0 3			
IRON-WORK.— Two muzzle lashing eye bolts, *diameter*	0 1¼				
the eyes in the clear......	0 2¾				
To have four ring and two eye-bolts, to each port *diameter*	0 1⅜				
rings in the clear	0 5				
eyes in the clear	0 2				
Eye-bolts one between every port, *diameter* ...	0 1⅜				
eyes in the clear.........	0 2¼				
Ring-bolts one opposite each port in the deck, *diameter*	0 1⅛				
rings in the clear	0 3¾				
Stopper-bolts or ring-bolts for the stoppers... *diameter*.........	0 1⅝				
rings in the clear......	0 7				
TILLER.—To be clear of knots, and					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*
TILLER—*continued.*					
square at the fore part of the hole	0 11	0 10¾	0 8	0 6½	0 5½
To continue of that bigness before the rudder-head	2 3	2 0	1 3	1 0	0 10
Foremost end square	0 7	0 6¼	0 5	0 4½	0 3½
In length, or to pass freely by the mizen-mast	26 0	21 0	14 0	12 0	8 6
Eye-bolts driven in the tiller, and fore part of rudder ... *diameter* ...	0 1	0 0⅞			
PUMPS—To be fitted with pumps *in number*	*four*	*two*	2 *of*	2 *of*	1 *of*
size, if copper	1 0	1 0	0 7	0 5	0 5
size, if chain	0 7	0 7			
And two wood pumps with brass chambers size	0 7	0 7			
UPPER DECK.					
UPPER DECK CLAMPS.					
Strakes .... *in number*	*one*	*two*	*two*	*one*	*one*
Thick....*at the upper edge*	0 7	0 6	0 3½	0 3	0 3
lower edge	0 5½	0 5	0 3½	0 3	0 3
Scarphs ....*long*	4 6	3 10	3 0	2 9	2 9
Bolted at the lips with one bolt .... *diameter*	0 0⅞	0 0¾			
broad...		2 2	1 10	1 0	0 11
DECK HOOK ....*sided*	1 0½	0 11	0 9	0 8½	0 7
(Or as long as can be gotten) ....*length*	17 0	16 0	12 6	12 0	9 6
Bolts ....*number*	*thirteen*	*eleven*	*nine*	*seven*	*seven*
diameter	0 1⅛	0 1¼	0 1	0 0⅞	0 0¾
Ekeings to Deck-hook *deep or sided*	0 10	0 8			
Bolts ....*number*	*six*	*four*			
diameter	0 1¼	0 1⅛			
BEAMS—To round up	0 8	0 7	0 5½	0 7	0 6
Plank ....*thick*	0 3	0 3	0 2½	0 2½	0 2
Height from the upperside of the plank to the upperside of the quar-					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. GUNS 60	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
BEAMS—*continued.*										
ter-deck beam in midships ....*afore*...	6	10	6	5						
abaft...	7	0	6	7						
Height from the upperside of the plank to the upperside of the Roundhouse beam in midships *afore*...	...		...		5	9				
abaft...	...		...		6	1				
Height from the upperside of the plank to the upper side of the forecastle beam in midships *afore*	6	7	6	2	5	3				
abaft	6	7	6	2	4	9				
Depth of the waist from the upperside of the plank at the lowest place	6	9	6	9	3	0	0	3	0	5
Height from the upper edge of the rabbet of the keel to the upperside of the beam in the middle line .... *afore*	...		...		...		17	2	11	6
midships .	...		...		...		16	6	10	9
abaft	...		...		...		20	9	13	1
Height from the plank to the port sills	2	0	2	2	1	0				
PORTS.................*deep*..........	2	8	2	5	1	10				
fore and aft...	2	10	2	10	2	3				
Distance from each other	8	1	7	2	7	6				
number	30		26		20					
Foreside of the foremost port, abaft the foremost perpendicular	13	1	10	4	6	4				
Aftside of the after port, afore the after perpendicular.....................	6	9	4	6	8	3				
SILLS ....Lower sills, *deep*......	0	6¼	0	6	0	4				
Upper sills, *deep*	0	5½	0	5	0	3				
BEAMS ....*sided*	1	1½	1	1	0	9	0	8½	0	7

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. TONS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
BEAMS .... *moulded* ...	1 0	0 11	0 7	0 7	0 5½
number	28	27			
or asunder about	...	...	3 4	3 4	3 4
Bolts in the scarphs, *number in each*	*eight*	*eight*	*six*		
square iron, *diameter*	0 1	0 0⅞	0 0¾		
TRANSOM.—Deep or sided	0 11	0 8½	0 6½	0 6	0 5¾
Moulded middle (or broader)	1 1	0 11	0 10	0 8	0 6½
at the ends ...	0 11	0 9	0 8	0 6	0 5¾
Scored on and bolted through each counter timber: bolt's *diameter*	0 1	0 0⅞	0 0¾		
Knee'd at each end with a knee to cast before the second beam from aft *sided* ..	0 8	0 7			
thwartship arm, *long* ...	4 6	4 0	4 3		
Bolts, number in fore and aft arm	*five*	*four*	*four*		
number in thwartship arm	*four*	*three*	*three*		
diameter ...	0 1⅛	0 1	0 0⅞		
If iron, to weigh about *cwt.*	...	...	1 1 0		
FILLINGS abaft the transoms, of oak, *deep*	0 8				
KNEES.—The beams to be knee'd at each end with hanging and 1 lodging knee,					
hanging knees, *sided*	0 9	0 8½	0 5¾	0 5	0 4¾
hanging arm, *long* ...	5 6	5 0	3 9	3 6	3 0
Thwartship arm, *long*	3 9	3 8	3 0	2 9	2 6
Number of bolts in the Hanging arm	*five*	*five*	*four*	*three*	*three*
Thwartship arm	*four*	*four*	*three*	*three*	*three*
bolt's diameter	0 1⅛	0 1¼	0 0⅞	0 0⅞	0 0¾
Lodging Knees ......*sided*	0 8	0 8	0 5½	0 5	0 4¼
thwartship arm long	4 3	4 2	3 0	2 10	2 9
Fore and aft arm length sufficient for bolts at least	*four*	*four*	*three*	*two*	*two*
diameter	0 1⅛	0 1¼	0 0⅞	0 0⅞	0 0¾

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
TOP RIDERS—Number on each side.	12	9			
sided ...	1 $0\frac{1}{2}$	0 $11\frac{1}{2}$			
moulded	0 $11\frac{1}{2}$	0 $10\frac{1}{2}$			
To stand as diagonally as possible, and to have two bolts through the beams they face on.					
Bolted with bolts *in number*	*nine*	*nine*			
diameter ...	0 $1\frac{1}{4}$	0 $1\frac{1}{8}$			
PARTNERS — Mainmast Partners *broad* ...	1 6	1 3	0 10	0 10	0 7
And fitted as those on the Gun-deck					
deep	1 5	1 2	0 8	0 8	0 6
Asunder in the clear...	4 0	3 4	2 8	2 4	1 10
Uppersides above the beam	0 9	0 $6\frac{1}{2}$	0 4	0 4	0 3
Fore-mast Partners. *broad*...	1 2	1 1	0 10	0 9	
deep	1 3	1 0	0 8	0 7	
Asunder in the clear...	3 10	3 0	2 6	2 2	
Uppersides above the beam	0 8	0 6	0 4	0 3	
Two bolts in each end... *diameter*.	0 1	0 $0\frac{7}{8}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	
Mizen-mast Partners *thick* ...	0 5	0 $4\frac{1}{2}$	0 3		
broad...	5 0	4 6	2 9		
Scored down upon the beams and ledges......	0 1	0 $0\frac{3}{4}$	0 $0\frac{1}{2}$		
Fastened with bolts, *number*	*eight*	*eight*	*four*		
diameter ...	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{5}{8}$		
STEP of the BOWSPRIT—To be of two pieces ... *square*...	...	...	0 8	...	0 6
Run up to make topsail sheet bitts—*asunder in the clear*	...	...	2 2	...	1 3
Chocks to be thick	...	...	0 6	...	0 5
Laps of the chocks thick on the foreside	...	...	0 3	...	0 $2\frac{1}{2}$
Bolted by bolts *in number*	...	...	*four*	...	*four*
diameter	...	...	0 $0\frac{3}{4}$	...	0 $0\frac{3}{4}$

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks.	Frigate.	Merchant Ship.	Brig.	Sloop.
	GUNS 74	GUNS 36	TONS 330	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
STEP for the CAPSTAN—*broad*....	...	1 8	1 3		
deep	...	1 4	1 4		
Upperside above the deck	...	0 4	0 6		
Laps to extend to the further sides of the beams, and to have two bolts through each lap, *diameter*	...	0 1⅛	0 1		
CAPSTAN-PARTNERS — Main and fore ....*thick*	0 7				
broad......	7 0				
Framed with carlings *broad*	0 10				
deep	0 11				
Carlings asunder in the clear	5 9				
Let down between the beams	0 1				
Framing bolted with bolts *in diameter* ...	0 0⅞				
Partners bolted, two in each end, *in diameter*...	0 0⅞				
Iron hoop fitted in the partners .....*broad*......	0 4				
thick......	0 0½				
RIDING BITTS	...	See Gun Deck.	See Gun Deck.	See Gun Deck.	See Gun Deck.
MAIN, JEAR, and TOPSAIL SHEET BITTS, *square*, from	1 1	1 0	0 9	0 7½	
the lower side of upper deck beam, to above the deck......	2 8	2 8			
Heads above the deck or tenons into the quarter deck beams	...	...	3 1	3 0	

The jeer and topsail sheet bitts should spread equally from the middle line, that their outsides may plumb with the centre of the pumps.

CROSS-PIECES to the jeer and topsail sheet bitts, to be *broad*	0 10	0 8½	0 7	0 6¼	
deep......	0 8½	0 7¼	0 5½	0 4¼	
Upperside above the deck	1 10	1 10	1 6	1 7	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
CROSS PIECES—*continued.*										
Scored on, and faced upon the bitts	0	1½	0	1½	0	1¼	0	1¼		
Ends without the bitts ...	2	0	1	5	1	4	1	3		
Bolted at each end to the bitts, with two bolts, *diameter* ...	0	0⅞	0	0⅞	0	0¾	0	0¾		
GALLOWS CROSS-PIECE...... *sided*...	0	10	0	9	0	6¾	0	6½		
deep...	1	4	1	2¾	0	10½	0	9		
long...	12	6	10	9	8	6	8	3		
upperside above the deck...	7	0	6	8	5	4	5	2		
(*** These are only used in the navy when the quarter deck is short of the topsail sheet bitts.)										
Gallows Bitts and Cross Piece to be fitted in the fore hatchway, as those abaft in scantling and height for the booms to lie on, if required.										
CARLINGS.—Number of tiers on each side from the fore hatch to the mizen mast room	*three*		*three*		*two*		*two*		*two*	
Thence forward and aft *number of tiers*	*two*		*two*		*two*		*two*		*two*	
The carlings ... *broad* ...	0	8	0	7½	0	6½	0	6	0	5
deep	0	6	0	6½	0	5	0	5	0	4
Half beams of fir abaft the mizen mast room *broad*	0	10	0	9						
deep	0	7½	0	6½						
LEDGES .... *broad*	0	4½	0	4	0	4	0	4	0	3
deep......	0	4	0	3½	0	3¼	0	3¼	0	2¼
COAMINGS.—To the hatchways, and to extend the whole length of ladderways, &c.										
thick underside	0	11	0	6	0	6	0	5	0	4
thick upperside	0	10	0	5	0	5	0	4	0	3½
stand above the deck	0	3½	1	3	0	2½	1	0	1	0
Bolted, two bolts in a beam, *diameter*.........	0	0¾	0	0¾	0	0¾	0	0¾	0	0⅝
Scored down between the beams	0	1	0	1	0	0⅞	0	0⅞	0	0¾

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks.		Frigate.		Merchant Ship.		Brig.		Sloop.	
	GUNS 74		GUNS 36		TONS 330		TONS 170		TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
HEAD LEDGES. .... *thick* ...	0	5½	0	5	0	3½	0	3	0	3
And round up more than the beam	0	1½	0	1⅜	0	1	0	1½	0	1
							Hatches.			
GRATINGS.—Ledges fir ... *broad*...	0	3	0	3	0	2½	0	2½	0	2½
deep ...	0	3½	0	3½	0	3	0	3	0	3
Battens oak...... *broad*...	0	3	0	3	0	2½	1¼ deal.			
thick ...	0	0¾	0	0¾	0	0¾				
WATERWAYS.—*(Or broader if clear of sap)*......... *thick* ...	0	5	0	5	0	3½	0	3	0	3
broad...	0	11	0	11	0	10	0	9	0	9
bearded back	0	0¾	0	0⅝	0	0⅜	0	0⅜	0	0¼
FLAT of the DECK.—Dantzick deal *thick* ...	0	3	0	3	0	3	0	2½	0	2
Except English oak plank next waterways, *number of strakes*	*four*		*four*		*three*		*two*		*two*	
Two oak binding strakes next the coaming	0	4	0	4	*one* 0	4	0	3	0	3
SPIRKETTING.—On each side strakes *number*	*two*		*two*		*one*					
Thick at the *lower edge*...	0	5	0	4	0	3				
upper edge ..	0	4	0	4	0	3				
Bolts, one through each butt, and two through each lower sill, *diameter*	0	0⅞	0	0⅞	0	0¾				
STUFF between the ports or quick-work .... *thickness*	0	3	0	3	0	2				
STRING in the Waist, *number of strakes on each side*	*two*		*two*							
thick at the upper edge	0	5	0	4						
Bearded from half its depth, to *thickness at lower edge*..............	0	4	0	4						
Scarphs between drifts and into the clamps *long*...	4	6	4	0						
Bolted through at every other timber at opposite edges, *bolt's diameter*	0	0⅞	0	0¾						
GUNWALE, or PLANK SHEER, *thick*	0	4	0	3	0	4	0	3	0	2½
Bolts through the scarphs										

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
GUNWALE—*continued.*					
at every two feet six inches...... *diameter*...	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝
Plank sheers along the drifts .... *thick* ...	0 3	0 2½	0 2½		
Broad enough to project for the mouldings and bolts through, *diameter*	0 0¾	0 0⅝	0 0⅝		
ROUGHTREES.—To fit oak roughtrees along the midships.......... *broad* ...	...	...	0 6	0 4	
deep	...	...	0 4	0 3	
COLLAR BEAM.—Against the beakhead .... *square*	0 11				
The side ends to be knee'd with an iron knee *weight*...	1 1 14				
Bolts in each ... *number* ..	*seven*				
diameter	0 1				
*** *The upperside to be kept to the same height at the lower sills of the ports.*					
BEAKHEAD STANTIONS. — Those next the bowsprit *square*	0 11				
asunder in the clear	3 3				
And square above the collar beam	0 7½				
Other beakhead stantions *fore and aft*	0 7½				
Thwartships and rabbetted for 1½ inch deal	0 8				
To face on to the cat beam	0 1½				
And bolted each with two bolts .... *diameter*	0 0¾				
*** *If half beams form the beakhead, which is common of late years, (the collar beam being gotten with difficulty to cast over the bowsprit) the whole is*					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
BEAKHEAD STANTIONS—*continued.* *united by a carling and an iron strap.*					
BEAKHEAD CARLING....... *broad*...	1 3				
deep....	1 4				
IRON STRAP. .... *broad*...	0 $4\frac{1}{2}$				
thick...	0 $0\frac{7}{8}$				
Bolted about every 16 inches, bolts... *diameter*	0 $0\frac{7}{8}$				
SEAT TRANSOM.—*Broad or deep*...	0 9	0 8	0 6		
thick..	0 7	0 6	0 4		
Scored aft upon the counter timbers, and bolted through each, *diameter*	0 $1\frac{1}{8}$	0 1	0 $0\frac{7}{8}$		
Knee'd at each end with an iron knee, *weight*...	1 2 14	1 1 7	1 0 14		
Fore and aft arm take three bolts afore gallery door. Thwartship arm, *long*	4 0	3 9	3 6		
Bolts, *diameter*	0 $1\frac{1}{8}$	0 1	0 $0\frac{7}{8}$		
*** *The upperside is kept to the same height as the lower sills of the ports.*					
STANDARDS.—Number on each side	*five*	*four*	*three*		
If wood, *sided*	1 0	0 9			
Iron each, weight ... *cwt.*	2 2 0	1 3 14	1 2 0		
Side arm, *long*	5 9	5 6	4 9		
Thwartship arm, *long*....	3 10	3 6	3 4		
Bolts in each ... *number* .	*nine*	*eight*	*seven*		
diameter	0 $1\frac{1}{4}$	0 $1\frac{1}{8}$	0 $0\frac{7}{8}$		
BREASTHOOK under the bowsprit *sided*...	...	0 10	0 9	0 9	
To be placed as high as can be under the bowsprit without cutting it. Bolts, *long*	...	15 0	12 6	11 6	
number...	...	13	*nine*	*nine*	
diameter .	...	0 $1\frac{1}{8}$	0 1	0 1	
*** *And another breasthook over the bowsprit, of the same dimensions, if room will admit.*					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
IRON WORK TO PORTS, &c.										
To have two ring and two eyebolts to each port, *diameter*	0	1¼	0	1¾	0	1				
rings in the clear	0	4¾	0	4¾	0	3¼				
eyes in the clear...	0	2	0	2	0	1¾				
Training eye bolts, one between each port, *diameter*.........	0	1¼	0	1¼	0	1				
eyes in the clear	0	2	0	2	0	1¾				
Ring bolts in the deck abreast each port, *diameter*.................	0	1	0	1						
rings in the clear	0	3¼	0	3¼						
Stopper bolts (See Gun-deck) one in each beam before the main hatchway ... *diameter*	...		0	1½	0	1¼	0	1⅛	0	1
rings in the clear	...		0	5½	0	4¾	0	4¼	0	3½
Toptackle eye bolts, two to the main and two to the foremost, *diameter*	0	1⅝	0	1⅝	0	1¼	0	1⅛	0	1⅛
eyes in the clear	0	4	0	3¾	0	3¼	0	2¾	0	2½
Triangular ring bolts for lashing booms and anchors, *diameter*	0	1½	0	1⅜	0	1	0	0⅞		
rings in the clear	0	9	0	9	0	6	0	4½		
Eye bolts in front of quarter deck and forecastle beams, *diameter*	0	1¼	0	1⅛						
eyes in the clear	0	2¾	0	2¾						
On each side... *number*...	*three*		*three*							
Eye bolts round the main and fore mast, *number to each*	*eight*		*eight*		*eight*		*six*		*six*	
In the spirketting abreast of each mast,	*six*		*six*		*six*		*three*		*three*	
diameter...........	0	1⅛	0	1	0	0⅞	0	0¾	0	0¾
Round the mizen mast, *number*......	*six*		*six*		*five*					
In the spirketting abreast the mast ...	*four*		*four*		*three*					
diameter...	0	1	0	0⅞	0	0¾				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
PILLARS.—*Square.*										
Lower end	0	6½	0	6¼	0	4¼				
Upper end	0	5½	0	5¼	0	4				
Iron pillars near capstan and galley. *square* ...	0	2	0	1¾						
TILLER.—To have a tiller of the size of the lower tiller and two-thirds of the length.										
SCUPPERS.—On each side, *number*	*seven*		*seven*		*four*		*three*		*three*	
diameter in the clear	0	4	0	4	0	3	0	2	0	2
Scupper abreast the pump and in the manger, *diameter in the clear* ...	...		0	5	0	4	0	3	0	3
MANGER............................	...		See Gun Deck.							
CAPSTANS.										
Centre of main jear capstan, abaft the centre of the main mast.......	23	9	21	0						
Centre of fore jear capstan, abaft centre of fore mast	47	0								
Barrel......... *diameter*...	2	4¼	1	10¼						
WINDLASS.										
Length....................	...		...		20	0	14	10	13	0
Diameter in the middle..	...		...		1	10	1	3½	1	2
Diameter at the ends	...		...		1	6	0	11½	0	11
Abaft the foremast's centre	...		...		4	6	2	0		
Underside above the deck, about	...		...		1	0	0	11	0	11
Iron spindles... *in number*	...		...		*three*		*three*		*two*	
Middle spindle, *long*......	...		...		4	3	4	0		
diameter in the middle .	...		...		0	3½	0	3¼		
diameter at the ends	...		...		0	2½	0	2¼		
End spindles...... *long*...	...		...		5	3	4	6	4	0
diameter in the middle .	...		...		0	3½	0	3	0	2¾
diameter at the ends ...	...		...		0	2½	0	2	0	2
Pall hoops ...... *number* .	...		...		*four*		*two*		*two*	
Each .... *thick*	...		...		0	2½	0	2	0	2

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
WINDLASS—*continued.*					
Bolt holes ... number...	...	...	*four*	*four*	*four*
diameter .	...	...	0 0¾	0 0⅝	0 0⅝
Brass gudgeons	...	...	*three*	*two*	*two*
But if rhodings to have bolts .... *in number*	...	...	*three*	*three*	*three*
diameter .	...	...	0 0¾	0 0⅝	0 0⅝
Cheeks......... *number...*	...	...	*three*	*two*	*two*
thick	...	...	0 6½	0 5	0 4¾
broad	...	...	2 7	1 0	1 0
Bolts in number	...	...	*three*	*two*	*two*
diameter .	...	...	0 1	0 0⅞	0 0⅞
Bar holes, *number in the length*	...	...	*eleven*	*nine*	*seven*
square ...	...	...	0 3	0 2¾	0 2¾
Hoops on the ends, *thick*	...	..	0 0¾	0 0½	0 0½
broad	...	...	0 2¼	0 1¾	0 1¾
Elm or fir facings, *thick* .	...	...	0 1¾	0 1½	0 1½
Iron palls .... *number*	...	...	*six*	*two*	*two*
square	...	...	0 1¾	0 1½	0 1⅜
Upper palls....... *long...*	...	...	1 5	1 1	1 0
Lower palls ...... *long...*	...	...	0 10		
PALL BITTS.—Middle...... *broad* .	...	...	1 3	1 2	0 10
thick .	...	...	1 1	1 1	0 10
Side ones .... *broad* .	...	...	1 1	1 0	0 9
thick .	...	...	1 1	1 0	0 9
CANT.—From side to side at the windlass bitts...*square* .	...	..	0 6	0 5	
WINCH.—Abaft the main mast	...	...	...	0 9	0 7
Bitts .... *broad* .	...	...	...	0 9	0 8
thick ..	...	...	...	0 4	0 4
asunder in the clear	...	...	...	3 10	3 9
Spindle *up from the deck*	...	...	...	3 6	3 6
diameter	...	...	...	0 1⅞	0 1¾
length .	...	...	...	7 0	7 0
Chocks .... *long* ...	...	...	...	1 1	1 0
Inner end .... *diameter*	...	...	...	0 7	0 6½
Outer end .... *diameter*	...	...	...	0 5½	0 5
Hoop on the ends, *thick...*	...	...	...	0 0⅜	0 0¼
broad...	...	...	...	0 1	0 1¼
Pall hoop .... *thick* ...	...	...	...	0 0⅞	0 0⅞
diameter	...	...	...	0 7¾	0 7½

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*
WINCH—*continued.*					
Pall .... *square* ..	...	...	...	0 0⅞	0 0⅞
long	...	...	...	0 6	0 6
Bolt .... *diameter*	...	...	...	0 0⅝	0 0⅝
Knees against the bitts *sided*...	...	...	...	0 3	0 3
Arms .... *long* ...	...	...	...	1 6	1
Bolts in each arm, *number*	...	...	...	*two*	*two*
diameter	...	...	...	0 0¾	0 0¾
QUARTER DECK.					
QUARTER DECK. — One or two strakes upper edge, *thick*	0 5	0 4			
CLAMPS.—Lower edge ... *thick* ...	0 4	0 3			
broad ...	enough to work to the upper deck ports.				
BEAMS .... *to round up*	0 8½	0 8			
plank thick	0 3	0 3			
Height from the upperside of the plank to the upperside of the roundhouse beam at middle line .... *afore*.	6 6				
abaft...	6 8				
Height from the upperside of the plank to the port sills, *gun ports*	1 10	1 7			
carronade ports	0 11	0 11			
Gun ports, *number on each side*	*seven*	*five*			
fore and aft	2 9	2 5			
deep	2 6	2 4			
Carronade ports on each side ...... *number*	...	*three*			
fore and aft .	...	3 4			
deep	...	2 7			
PORT SILLS............ *deep*	0 6	0 5			
LENGTH from the aftside of the midship stern timber to the foreside of the foremost beam	90 0	65 6			

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. GUNS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*
Beams.—The quarter-deck beams					
sided	0 10	0 8½			
moulded .	0 9	0 7			
The beam on each side the capstan... *sided*	...	0 9½			
In number	26	22			
Number of bolts in the scarphs.................	*eight*	*eight*			
diameter	0 0⅞	0 0¾			
Breast beam ... *sided*	1 3	1 1			
deep	1 1	0 11			
Transom................. *deep*	0 8	0 7			
Round up agreeably to the lights below, and moulded as broad as can be gotten.					
One iron knee at each end, to cast under the beams, and weigh *cwt.*	2 1 0	1 3 0			
To take two bolts before the gallery door, *diameter*	0 0⅞	0 0⅞			
Thwartship arm to have three bolts, and be long enough to take a bolt in the timber next the side.					
Knees.—Every beam to be knee'd at each end with 1 hanging and 1 lodging knee.					
Hanging knees, *sided*	0 7	0 6			
Hanging arm to reach down upon the spirketting, 6 inches.					
Thwartship arm .... *long*	3 3	3 0			
To have in each knee bolts......... *in number*	*eight*	*eight*			
diameter .	0 0⅞	0 0⅞			
Lodging knees, *sided*	0 6¼	0 5¼			
Thwartship arm, *long* ...	3 6	3 3			

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
KNEES—*continued.*										
Side arm the whole length between the beams, or for three bolts, *diameter*	0	0⅞	0	0⅞						
CAPSTAN PARTNERS ...... *thick* ...	...		0	6						
broad ...	...		5	0						
STEERING WHEEL STANTIONS, *broad*	1	2	1	1						
thick	0	6	0	5						
Heads above the deck ...	4	0	3	9						
Barrel .... *length*	2	8	2	4						
diameter { *heads*...	2	2	1	8						
diameter { *middle*.	2	0	1	5						
Spindle .... *square*	0	1¾	0	1½						
WATERWAYS........ *thick*	0	4½	0	4						
bearded back	0	0⅜	0	0⅜						
FLAT of the Deck, to be of Prussian deal .... *thick*...	0	3	0	3						
except English oak plank, which is used next the waterways, *strakes in number*	*two*		*two*							
SPIRKETTING. — English plank, *thick*....................	0	4	0	3½						
QUICKWORK — between the ports *thick* ...	0	2½	0	2						
ROUGHTREE RAIL......... *broad* ...	...		0	8						
deep	...		0	5						
Underside above the deck	...		3	7						
IRON WORK to PORTS.										
Carronade Ports.										
Ring bolts diameter	...		0	1¼						
Rings in the clear...	...		0	5						
Eyebolts diameter...	...		0	1⅛						
Eyes in the clear	...		0	2						
Gun Ports.										
Ring bolts, diameter	0	1¼	0	1⅛						
Rings in the clear...	0	4½	0	4¼						
Eyebolts diameter...	0	1¼	0	1⅛						
Eyes in the clear ...	0	2	0	1⅞						
SCREEN BULKHEAD.—Stiles, *square*	0	6								
PILLARS.—Square at the head	0	5								
TRANSOM .... *deep*.	0	6	0	5						

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
TRANSOM—*continued.*					
Knee'd at each end with one iron knee ... *cwt.*	1 1 14	1 1 0			
Fore and aft arm... *long* .	5 6	5 0			
Thwartship arm ... *long* .	3 6	3 3			
Bolts............ *in number*	*seven*	*seven*			
diameter	0 1	0 0⅞			
Transom above the taffarel .... *in the clear*	...	0 11			
broad	...	0 11			
deep	...	0 4½			
ROUNDHOUSE.					
ROUNDHOUSE .... *breadth* ..	1 1	...	0 11		
thickness	0 4	...	0 4		
CLAMPS.—Bearded at lower edge to	0 3¼	...	0 3		
Bolted with bolts, *diameter*	0 0¼	...	0 0¼		
LENGTH taken from aftside of stern timber to foreside of the foremost beam	51 0	...	34 0		
BEAMS.—To round up	0 9	...	0 8		
plank, *thick*	0 2½	...	0 2		
HEIGHT from the plank to the port sills .... *carronade ports*	0 11				
Carronade ports *in number*	8 *or* 6				
fore and aft	3 2				
deep.........	2 9				
Port sills .... *deep*.........	0 9				
BEAMS .... *sided*	0 7	...	0 5		
moulded	0 6½	...	0 4		
in number ..	16	...	10		
Breast beam, *sided*	1 0	...	0 9		
deep.........	0 10	...	0 8		
TRANSOM .... *deep*.........	0 8	...	0 4		
broad	0 11	...	0 8		
One iron knee at each end; fore and aft arm to cast under the beams, and take one					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks.	Frigate.	Merchant Ship.	Brig.	Sloop.
	GUNS 74	GUNS 36	TONS 330	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
TRANSOM—*continued.* bolt afore the gallery door; thwartship arm, one in the timber next the side............ *cwt.*	1 1 0	...	0 3 7		
Bolts, *number* ...	*seven*	...	*six*		
diameter .	0 0¾	...	0 0¾		
KNEES to the BEAMS.—Wood, *sided*	0 5¼				
Hanging arm to reach on the spirketting	0 6				
Thwartship arm...... *long*	2 9				
Bolts in knees ... *number*	*seven*	...	*four*		
diameter	0 0¾	...	0 0⅝		
Iron hanging knees to weigh .... *each* ...	0 3 17	...	0 2 7		
Lodging knees... *sided* ...	0 5¼	...	if wood		
Fore and aft arms, the length between the beams, *thwartship arm long*	3 0				
Bolts in the knees, *number*	*six*	...	Dog bolts	through	the side.
diameter	0 0¾				
BRACE BITTS.—Made of two knees, each............... *sided*	0 7½	...	0 5		
To stand above the deck	3 0	...	2 9		
Scored ¾ of an inch on the beams, and bolted with two bolts...... *diameter*	0 0⅞	...	0 0¾		
To have two sheaves in each .... *diameter*	0 8	...	0 5½		
and *thick* ...	0 1⅛	...	0 0¾		
Instead of a cross-piece to have an iron pin, *diameter*	0 1¼	...	0 1⅛		
COMPANION.—Coamings or framing .... *thick*	0 4	...	0 3½		
To stand above the deck	0 10	...	0 7		
Fore and aft in the clear	5 2	...	1 10		
Thwartships in the clear	5 9	...	5 0		
TAFFAREL KNEES.—The fore and aft arm to be bolted through three beams.					

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	ft. in.	t. in.	ft. in.	ft. in.	ft. in.
TAFFAREL KNEES—*continued.*					
Midship knee arm against the taffarel .... *long*	7 6				
sided	0 9½				
Knee on each side the midships......... *sided*	0 7				
FIFE RAIL .... *broad*	0 11	...	0 8		
deep .	0 4	...	0 3		
WATERWAYS................ *thick*	0 4	...	0 3		
FLAT.........deal............ *thick*	0 2½	...	0 2		
SPIRKETTING................. *thick*	0 2½	...	0 2		
ROUGHTREE RAIL............ *broad*	0 8	...	0 5½		
deep	0 6	...	0 4½		
Underside above the deck	3 9	...	3 0		
Birthing up the underside of roughtree deal, *thick*	0 2				
IRONWORK to the PORTS, and					
Ring bolts in diameter	0 1¼				
Rings in the clear	0 4½				
Eye bolts diameter ...	0 1½				
Eyes in the clear	0 2				
FORECASTLE.					
FORECASTLE CLAMPS, *thick upper edge*....................	0 5	0 4	0 3		
bearded to lower edge to	0 4	0 3	0 2½		
broad	To work down to the ports.	...	0 11		
BEAMS .... *to round up*	0 8	0 6½	0 6		
flat, *thick*	0 3	0 9	0 2		
Height from the flat to the port sills, *gun ports*	1 11				
carronade ports	0 11	0 11			
CARRONADE PORTS .... *number*	*two*	*two*			
fore and aft	3 4	3 4			
GUN PORTS............ *number*	*two*	*two*			
fore and aft	3 0	2 7			
LENGTH on the Forecastle	50 0	36 0	20 6		
Beams to be *sided*	0 9½	0 8	0 6		
moulded	0 9½	0 7	0 5		
in number .,	*thirteen*	*ten*	*five*		
Number of bolts in the scarphs.................	*eight*	*eight*			
diameter ...	0 0⅞	0 0⅞			

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
LENGTH—*continued.*					
Breast beams, *sided*	1 2	1 0	0 10		
deep	1 1	0 11	0 9		
Cat beam ... *broad*	3 0				
deep	0 10½				
Bolts at every 20 inches asunder ... *diameter* ...	0 1				
Rabbet on the after edge *deep*	0 4				
broad........	0 5				
CATHEADS .... *fore and aft*	1 5¼	1 3	0 11	0 9½	0 7
deep	1 4½	1 1	0 10	0 9	0 7
To stand square with the bow, and to stive upwards in every foot....	0 6	0 5½	0 5	0 5	0 5
Length without board (*or sufficient to swing the anchor clear of the bow*)	8 6	7 6	4 10	4 0	3 0
Length within board from the outside of the timber	8 6	9 0	6 9		
Catheads and cross-chock bolted through the catbeam .... *diameter*...	0 1¼	0 1	0 0¾	0 0¾	0 0¾
In the outer end of each to have sheaves.........	*three*	*three*	*three*	*two*	*two*
diameter	1 3	1 1	0 8½	0 8	0 7
thickness	0 2¼	0 2	0 1⅛	0 1	0 1
Knee at the aftside of the cathead .... *sided*	0 7¼	0 6			
Fore and aft arm ... *long*	4 9	4 7			
Thwartship arm .... *long*	3 6	2 9			
Bolts............ *in number*	*seven*	*six*			
diameter	0 1⅛	0 1			
Every beam of the forecastle to have one hanging knee at each end					
sided.......................	0 8	0 6			
Iron weight ......*cwt*......	...	...	0 2 21		
thwartship arm long, and hanging arm to reach the spirketting.	3 3	2 10	2 6		

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
CATHEADS.—*continued.*					
Bolts in each knee *number*......	*eight*	*seven*	*six*		
diameter.....	0 1	0 0⅞	0 0¾		
Lodging knees, one on each side, abaft the cat beam.........*sided*.....	0 7				
One on each side, abaft every forecastle beam, *sided*.....	0 6	0 5	0 3¾		
Thwartship arm...*long*...	3 7	3 2	2 10		
Bolts in each knee, *in number*	*six*	*six*	*four*		
diameter...	0 0⅞	0 0⅞	0 0¾		
FORE JEAR and TOPSAIL SHEET BITTS......... *square*...	1 0	0 9			
Heads above the deck ...	3 10	3 7			
CROSS-PIECES.—One to each, *deep*	0 7	0 5½			
broad	0 9	0 7½			
Scored on the bitts	0 1½	0 1¼			
Bolted, one bolt in each bitt............ *diameter*	0 1	0 0⅞			
WATERWAYS............... *thick* ...	0 4	0 4	0 3		
Strakes of English plank next the waterways *number*	*two*	*one*	*one*		
The remainder of the flat, to be of Prussian deal *of*	0 3	0 3	0 2		
SPIRKETTING.—To be .... *thick*...	0 3½	0 3	0 2½		
TIMBER HEADS.—To be above the planksheer	1 8	1 6	1 6	1 2	1 0
Timber-head for anchor-stopper above planksheer	2 6	2 2	2 0	1 8	1 6
PLANKSHEER .... *thick*...	0 3	0 3	0 3	0 3	0 2½
Broad enough for a moulding outside and in.					
CAT BLOCKS .... *broad*...	1 1	0 11	0 8	0 8	0 8
deep ...	0 11	0 9	0 6	0 6	0 5
Sheave......... *diameter*..	1 0	0 10	0 7	0 7	0 7
thickness..	0 2¼	0 2	0 1⅜	0 1⅛	0 1⅛

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
BREASTHOOK over the BOWSPRIT *sided* ……	…	0 9			
length ….	4 0	13 0			
Bolts ……… *in number*	*six*	*twelve*			
diameter ..	0 1⅛	0 1			
IRON-WORK to the PORTS, as on quarter deck.					
HEAD.					
Length from the foreside of the stem to the fore part of the knee ……..	15 0	11 3	9 3		
Breast of the scroll or figure distant from the stem …………………	15 9	11 6	9 6		
Hair bracket, the fore part abaft the breast of the figure ………………	3 9	2 7	1 10		
Height from the upper edge of the rabbet of the keel to the: Lower side of the lower cheek at the stem ………….	26 3	21 1	20 6		
Upper side of the main rail at the stem ………….	34 0	27 3	25 6		
Upper part of the knee at the fore part……………	35 0	27 3	26 6		
Scroll of the hair-bracket ……….	38 3	30 6	29 3		
Upper part of the scroll or figure head ………….	42 0	32 3	30 6		
KNEE.—Sided at the stem, at the upper side of upper cheek ……………….	1 4½	1 1	0 11		
Sided at the fore part at the upper end ……….	0 5	0 4½	0 3¾		
Cutting down above the upper side of the upper cheek ……………….	0 10	0 9	0 6		
Lacing to run up and support the figure, upper end ………. *sided*	1 2½	1 0	0 9		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
HEAD—*continued.*					
Standard to be formed out of the knee, or a well grown standard *sided*	0 9½	0 8½	0 6½		
Iron straps, two over ditto, with three bolts, *diameter*	0 0⅞	0 0¼	0 0¼		
BOLTS in the KNEE.—The two upper to be in diameter					
in the knee	0 2⅜	0 2⅜	0 1⅝	0 1¼	
in the stem	0 2¼	0 2	0 1½	0 1¼	
The third bolt in diameter .... *in the knee*	0 2⅓	0 1⅞	0 1⅜	0 1	
in the stem	0 2	0 1¼	0 1¼	0 1	
The fourth bolt in diameter... *in the knee* ...	0 1⅞	0 1¼	0 1⅜		
in the stem ...	0 1¼	0 1⅝	0 1		
The fifth bolt in diameter					
in the knee ...	0 1¼	0 1½			
in the stem ...	0 1⅝	0 1⅛			
The lower bolts *in diameter*	0 1½	0 1¼	0 0⅞		
CHEEKS.—In number on each side	*two*	*two*	*two*		
Distance between the cheeks on a square at stem	2 6	1 9	1 8		
Arms of the cheeks, *length on the side*...........	11 9	8 6	6 6		
length on the knee, at least	6 3	5 0	3 6		
Lower cheek, *sided at the after end*..............	1 0	0 9	0 6½		
fore end	0 7	0 5½	0 4		
moulded along the side	1 2	0 11	0 8		
fore end	0 5	0 3¾	0 3		
Upper cheek, *sided at the after end*	0 11	0 8½	0 7½		
fore end	0 6	0 5	0 3½		
moulded along the side	1 1	0 10	0 7½		
at fore end	0 4¼	0 3½	0 3		
Cheeks to be bolted each with bolts ... *in number*	*twelve*	*ten*	*eight*		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks.		Frigate.		Merchant Ship.		Brig.		Sloop.	
	GUNS 74		GUNS 36		TONS 330		TONS 170		TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
HEAD—*continued.*										
Cheeks to be bolted each with bolts...*diameter*...	0	1¼	0	1⅛	0	0⅞				
MAIN RAIL, *moulded at the after end*	1	0	0	9½	0	6½				
fore end	0	6	0	5	0	3¼				
sided at the after end	0	9½	0	7½	0	5				
fore end	0	5¾	0	4½	0	2¾				
Scarphs long	1	8	1	6	1	2				
Lining on the inside to succour the scarphs *thick* ...	0	3½	0	3	0	1½				
Planksheer or lining upon the upperside .... *thick*	0	1¼	0	1¼	0	1				
Bolted at the after end with two or more bolts *diameter*	0	1⅛	0	1	0	0⅞				
MIDDLE RAIL.										
moulded at the after end	0	8								
fore end	0	4⅜								
sided at the after end	0	6								
fore end	0	3⅝								
LOWER RAIL.										
moulded at the after end	0	7¼	0	5¼	0	4¼				
fore end	0	4⅛	0	3½	0	2¾				
sided at the after end	0	5¼	0	4½	0	3¼				
fore end	0	3⅛	0	2¼	0	2				
SUPPORTERS.—To have a handsome supporter under each cathead .... *sided*	0	10	0	7½	0	5½				
The arm under the cathead in length, and the arm next the side as long as can be obtained	4	9	4	2	3	6				
Bolted through the cathead and side with bolts.........*in number*	*eight*		*seven*		*six*					
diameter	0	1⅛	0	1	0	0⅞				
HEAD TIMBERS.—Number of timbers in the head	*three*		*three*		*three*					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
HEAD—*continued.*										
Stem timber, or *that next afore the stem, sided*	0	7¼	0	6	0	4¼				
the second sided	0	5¼	0	4⅝	0	3¼				
the third sided...	0	4¼	0	3¼	0	2¼				
Foremost head timber afore the stem	8	0	5	6	5	3				
Heels of them to be bolted together by bolts *diameter*	0	1	0	0¾	0	0¾				
Rails to be fastened thro' the head timbers by bolts .... *diameter*	0	0⅞	0	0¾	0	0¾				
Iron knee-strap bolted abaft the second timber *diameter*	0	0¾	0	0¾						
BEAM.—Athwart the head *to round up*	0	2½	0	2	0	1½				
sided	1	0	0	9½	0	7				
deep......	0	10	0	7½	0	5¼				
KNEE.—One at each end of the aft side of the beam. *sided*	0	6¼	0	5	0	4				
arms long	2	10	2	6	2	0				
Bolts in each arm, *number*	*three*		*two*		*two*					
diameter	0	0⅞	0	0¾	0	0¾				
To have one or two bolts driven through the middle into the stem *diameter*	0	1	0	0⅞	0	0¾				
CROSS-PIECES.—To have one or two cross-pieces foremost ....*sided*	0	4¼	0	3	0	3½				
After.................*sided*	0	5¼	0	4						
FALSE RAIL.—The false rail to be sided	0	6¼	0	5	0	4				
Bolted to the main rail with bolts......*diameter*	0	0⅞	0	0⅞	0	0¾				
CARLINGS.—To have a fore and aft carling on each side of the gammoning. *sided* ...	0	5¼	0	4¼	0	4				
deep	0	6½	0	5½	0	4½				

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	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
HEAD—*continued.*										
LEDGES.—The flat of the head to be framed with ledges *broad*...	0	3	0	2½	0	2½				
deep	0	2½	0	2	0	2				
BOOMKINS. — One on each side, length sufficient to plumb with the outer end of the fore yard when braced sharp.										
To taper to ¾ of these Dimensions at the outer end. *sided* } fir, if oak three inches less. ...	1	3	1	1	0	9				
deep	1	4	1	2	0	10				
To be bolted through the beam and chock, with a bolt .... *diameter*	0	1¼	0	1⅛	0	1				
To have iron stays, *diameter*	0	1¼	0	1⅛	0	1				
SEATS of EASE, &c. as directed.										
IRON HORSES.............. *diameter*	0	2⅛	0	2	0	1½				
Stantions to ditto *diameter*	0	1⅝	0	1½	0	1¼				
Bolts with eyes to ship in the horses... ..*diameter*	0	1¼	0	1⅛	0	1				
GRIPE may be elm, sided the same as the knee, and moulded in the broadest place	3	9	3	2	2	8	1	9	1	2
Bolted with bolts, *diameter*	0	1¼	0	1⅛	0	0⅞	0	0⅞	0	0¾
And further secured with copper horse shoes, *thick*...	0	0⅞	0	0¾	0	0¾				
broad...	0	4¼	0	4	0	3¼				
Bolted through with bolts *in diameter*	0	0⅞	0	0¾	0	0¾				
number	*six*		*five*		*five*					
Gripe and front of the knee to be lined with thick lead, 12lbs. to the foot square.										
To run abaft the foremost end of the keel.........	10	0	9	0	6	0				

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	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
HEAD—*continued.*										
To run up to the top of the knee within......	5	0	4	0	3	0				
And to lap on each side .	0	7	0	6	0	5				
STERN.										
HEIGHT from the upper-side of the rabbet of the keel, to the Touch of the lower counter at middle line	30	9	25	9	22	6	16	0	11	1
Touch of the upper counter at middle line	34	3	28	0	24	3	17	2		
Upper part of lower balcony breastrail	42	6								
Or ditto above the plank of the deck	3	4								
Upper part of the taffarel	50	6	36	4	31	9	22	6	14	6
BREADTH of the Stern at the height of the top timber line .	25	0	20	9	15	0	15	8	10	0
LENGTH taken from the after perpendicular to the Touch of the lower counter at middle line	7	0	6	0	3	4	2	4	0	6
Touch of upper counter at middle line	9	0	7	6	4	5	3	2		
Counter timber at the height of the taffarel at middle line	13	4	10	3	7	0	4	10	1	11
ROUND-UP of the lower counter .... *upon a level*	0	9	0	7	0	5	0	5	0	4
Round aft of the lower counter *upon a level*	1	3	1	0	0	9	0	9	0	5
Lower counter rail...*thick*	0	7	0	4½	0	5	0	3	0	2½
broad	0	8	0	6	0	6	0	4	0	3
Hollow of the lower counter	0	6	0	4	0	5	0	2	0	2
Round up of the upper counter *upon a level*	0	11	0	8	0	7	0	6		
Round aft of the upper counter *upon a level*	1	3	1	1	1	1	0	9		
Upper counter rail, *thick*	0	7	0	5½	0	5	0	3		
broad	0	8	0	6	0	6	0	3¼		
Hollow of the upper counter.................	0	1½	0	1	0	1	0	1		
Length of the lower gallery rim from the aft										

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	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
STERN—*continued.* part of the side counter timber	13	0	11	0	10	6				
Length of the upper gallery rim from ditto	10	3								
Lower gallery lights in length on the rake	3	6	3	0	2	10				
breadth on a square	2	10	1	10	1	8				
Upper gallery lights in length on the rake	3	2								
breadth on a square	2	5								
Projection of the balconies from the side counter timber at the middle line	3	3								
Depth of the taffarel	3	4	2	4	2	10				
Siding of the quarter pieces	1	6	0	11	0	10	0	8		
COUNTER TIMBERS.—To have side counter timbers sided full the scantling of the frame, the after frame or two to be left full for that purpose.										
Moulded on a square at the ...... *heel*	1	10	1	6	1	0	0	9	0	7
lower counter	1	8	1	6	1	0	0	9	0	7
Moulded on a square at the............*head*	1	1	0	11	0	9	0	6	0	5
Two or three bolts thro' the heel of the after frame and head of the fashion piece, *diameter*	0	1⅛	0	1	0	0⅞	0	0⅞	0	0[illegible]
To have right aft counter timbers to form the stern lights and counter ports............ *number*	*six*		*six*		*four*		*four*		*fou[r]*	
sided at the heels	0	11	0	9	0	6½	0	6	0	
heads	0	6¼	0	5	0	4	0	4	0	
Moulded on a square at the .... *heels*...	1	1	0	10	0	7	0	7	0	
heads..	0	8	0	5½	0	5	0	5	0	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks.		Frigate.		Merchant Ship.		Brig.		Sloop.	
	GUNS 74		GUNS 36		TONS 330		TONS 170		TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
STERN—*continued.*										
The heels of the counter timbers to face down on the foreside	0	1⅜	0	1¼	0	1	0	0¾	0	0¾
And bolted through the transom with one bolt *diameter*	0	1⅜	0	1	0	0¾				
And further secured by iron strap to each, *thick*	0	1	0	0¾						
broad	0	5	0	4						
Bolts in the straps, six; in the timber, three; and in the transoms, three .... *diameter*	0	1	0	0⅞						
Intermediate counter-timbers, *number* (or as seem necessary)...............	*four*		*two*							
COUNTER PORTS.—To have one on each side in the lower counter...... *deep*	2	4	1	10	1	4				
(Hung with lids, as gun-deck) ...... *thwartships*	2	6	2	0	1	6				
Birthing up of lower counter plank .... *thick*	0	3½	0	3	0	3	0	2½	0	2
UPPER COUNTER. — Number of ports on each side......	*one*		*one*							
Birthing up of the second counter, to be of oak plank, rabbetted	0	2½	0	2	0	2				
thwartships	2	2								
N. B. *Ring and eye bolts of the counter ports the size of those at the ports of the respective decks.*										
RUDDER.										
The head to be long enough to receive a tiller above deck ... *deck*	*upper*		*upper*		*upper*		*upper or main deck.*			
*** *The head to be left as large as the main piece will convert.*										

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS 1 0	Sloop. TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
RUDDER—*continued.*					
Head to be athwartships	2 2	1 8	1 5	0 10½	0 9
fore and aft	2 4	1 10	1 5	0 11½	0 10
Lower hance *fore and aft* } *Back included*	4 3	3 4	2 8	2 0	1 2
Heel, *fore and aft* } *Back included*	5 10	4 7	4 0	3 0	2 0
Thickness or siding, agreeably to the stern post.	0 3½	0 3	0 2¼	0 2	
Thickness of the back	0 6	0 5	0 3	0 3	0 2
Thickness of the sole					
The rudder to be short of the underside of the keel at the ... *fore end*	0 9	0 9	0 5	0 2	0 2
after end	0 11	0 11	0 7	0 4	0 4
Bolted together with bolts *in number*	*seven*	*six*	*five*	*three*	*three*
diameter	0 1⅛	0 1	0 0⅞	0 0¾	0 0¾
The head of the rudder to be secured with iron hoops .... *in number*	*five*	*five*	*four*	*three*	*three*
broad	0 4½	0 4	0 3	0 2½	0 2½
thick	0 0⅝	0 0⅝	0 0⅝	0 0½	0 0½
To have holes between the hoops for the tiller *number*	*two*	*two*	*one*	*one*	*one*
To have holes between the hoops for the tiller...... *thwartships*	0 10¼	0 10½	0 7¾	0 6¼	0 5
deep	0 10¼	0 10½	0 7¾	0 6¼	0 [illegible]
(*To have a norman and chocks provided, for steadying the rudder head.*)					
Braces and pintles for hanging the rudder *Number of pairs*	*seven*	*six*	*five*	*five*	*f*[illegible]

The upper brace may be iron, and the straps sufficiently l[illegible] to turn and meet round the head of the post and standar[illegible]

The second brace in length from the rabbet of the post	4 8	3 9	1 9		

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	GUNS 74		GUNS 36		TONS 330		TONS 170		TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
RUDDER—*continued.*										
The lower brace in length from the rabbet of the post	7	0	6	0	3	0	2	3	2	0
PINTLES.—The upper pintle may be iron, and the straps long enough to turn and meet on the aftside of the rudder, and the straps of the other pintles to be in length within one inch of the back.										
Straps of the braces and pintles broad	0	4¼	0	4	0	3	0	2½	0	2½
Thickness in the shoulder at the return	0	1⅞	0	1½	0	1⅛	0	1	0	0⅞
Pintles ... *diameter*	0	3½	0	3	0	1⅞	0	1⅝	0	1½
long, each	1	2	1	0	0	9	0	8	0	7
N. B. *The lower pintle to be two inches longer than the others, and the dumb pintles about two-thirds of the others, in length.*										
To have one or two bolts in each brace and pintle ... *diameter*	0	1	0	0⅞	0	0¾	0	0⅝	0	0⅝
And at every six inches distance screws in the braces, and nails and screws in pintles *diameter*	0	0⅝	0	0½	0	0½	0	0⅜	0	0⅜
RING PLATE.—To have a ring as the lower hance, strapt and fastenings similar to a pintle.										
OUTBOARD.										
CHANNELS.—Main Channel *in length*	37	6	27	0	16	0	9	6	7	0
thick at the { *inner edge*	0	6	0	5¼	0	4½	0	4	0	5
thick at the { *outer edge*	0	4½	0	3¼	0	3	0	4	0	5
Breadth, or sufficient to clear the shrouds of the roughtree rail	1	8	1	8	1	3	1	0	0	5
Foremost end afore the centre of the mainmast	0	10	0	9	0	6	0	9	0	4

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	GUNS 74		GUNS 36		TONS 330		TONS 170		GUNS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
OUTBOARD—*continued.*										
Upper edge below the upper edge of the sheer rail, or top timber line	*well*		*well*		*well*		*well*		0	9
Bolted with bolts, *in number*	*nine*		*eight*		*seven*		*five*		*four*	
diameter	0	1¼	0	1¼	0	1	0	0⅞	0	0⅞
Fore Channel... *in length*	30	6	24	9	15	0	9	6		
thick at the { *inner edge*	0	6	0	5¼	0	4½	0	4		
thick at the { *outer edge*	0	4½	0	3¾	0	3	0	4		
Breadth, or sufficient to clear the shrouds of the roughtree rail...........	1	8	1	8	1	3	1	0		
But taper at the after end to stow the anchor.										
Upper edge in the same range as the main channel.										
Foremost end afore the centre of the fore mast	0	9	0	7	0	6	0	9		
Bolted with bolts, *in number*	*eight*		*seven*		*six*		*five*			
diameter	0	1¼	0	1¼	0	1	0	0⅞		
Mizen channel, *in length*	19	6	14	6	8	9				
thick at the { *inner edge*	0	5	0	4½	0	4½				
thick at the { *outer edge*	0	4	0	3½	0	3				
Breadth, or sufficient to clear the shrouds of the roughtree rail	1	8	1	8	1	1				
Upper edge above the range of the main channel, or	...		1	0	*well*					
Foremost end afore the centre of the mizen mast.....................	0	6	0	6	0	3				
Bolted with bolts, *in number*	*six*		*six*		*five*					
diameter	0	1⅛	0	1⅛	0	0⅞				
Iron T-plates, or supporters in lieu of wood knees, in *number, main channel*	*six*		*five*		*three*					

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	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
OUTBOARD—*continued.*					
number, fore channel	*five*	*four*	*three*		
Iron................. *broad*	0 4½	0 4	0 3½		
Thick at the shoulder	0 2¼	0 1¾	0 1½		
Thick at the toe......	0 1⅜	0 1⅜	0 1		
Length below the upper side of the channel	4 0	3 9	3 0		
Collar head bolt in the toe .... *diameter*	0 1½	0 1¼	0 1⅛		
Each plate to have an eye or ring in the upper end in the clear........	0 5½	0, 5	0 4½		
diameter	0 1⅛	0 1	0 0¾		
Weight of each T-plate about .... *cwt.*	1 1 0	1 0 9	0 2 7		
Two or three bolts in the arms ...... *diameter*	0 0⅞	0 0⅞	0 0¾		
Number of T-plates under the mizen channel	*four*	*three*	*two*		
The iron broad......	0 3½	0 3	0 2¾		
Thick at the shoulder	0 1½	0 1¼	0 1⅛		
Thick at the toe....	0 1	0 1	0 0⅞		
Length below the upper side of the channel.....	2 7	2 4	2 2		
Collar head bolt in the toe........*diameter*......	0 1⅛	0 1⅛	0 1		
Each plate to have an eye or ring in upper end in the clear................	0 3¾	0 3½	0 3		
diameter......	0 0⅞	0 0⅞	0 0¾		
Weight of each T-plate about................*cwt.*	0 3 0	0 2 7	0 1 7		
Two or three bolts through the arms, *diameter*......	0 0¾	0 0¾	0 0¾		
DEAD EYES in MAIN and FORE CHANNELS.					
Number in each main channel.................	*eleven*	*ten*	*six*	*four*	*three*
Number in each fore channel.................	*eleven*	*ten*	*six*	*four* 0 8	0 8
In diameter...............	1 4	1 1	0 10	0 4½	0 4½
thickness...............	0 9	0 7½	0 6		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74	Frigate. GUNS 36	Merchant Ship. TONS 330	Brig. TONS. 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
OUTBOARD—*continued.*					
Dead eyes for breast back stays in each channel....	*three*	*two*	*one*		
in diameter......	0 11	0 9	0 8		
thickness.........	0 6½	0 5	0 4½		
In the after end of each channel, to have one dead eye for topmast backstays, and one abaft that for the top-gallant backstays					
diameter	0 10	0 9	0 8		
thickness	0 6	0 5	0 4½		
diameter	0 8	0 7	0 6		
thickness	0 4½	0 4	0 3½		
STOOLS for topmast and top gallant backstay's dead eyes when there is not room in the after end of the channels ...... *long*	2 6	2 2			
broad...	2 2	2 0			
thick { *inner edge*	0 4	0 4			
thick { *outer edge*.....	0 3	0 3			
Stools to be bolted with two bolts, *in diameter* .	0 1⅜	0 1			
DEAD EYES.—Number in each mizen channel	*six*	*five*	*four*		
diameter...	0 11	0 9	0 8		
DEAD EYES.—Number in each mizen channel, *thickness*	0 6½	0 5	0 4½		
STOOL.—To have a stool abaft the mizen channel for the top-mast and top-gallant backstays					
long	2 4	2 2	1 9		
broad...	1 10	1 9	1 4		
thick { *inner edge*......	0 3½	0 3	0 3		
thick { *outer edge*......	0 2½	0 2	0 2		
Bolted with two bolts, *in diameter*	0 0⅞	0 0⅞	0 0¾		
CHANNELS.—Dead-eye for mizen topmast backstay, *diameter* ...	0 7	0 7	0 5		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
OUTBOARD—*continued.*										
CHANNELS.—Dead-eye for mizen topmast backstay,										
thickness ...	0	4	0	4	0	3				
Dead-eye for mizen top gallant backstay,										
diameter ...	0	5	0	5						
thickness ...	0	3	0	3						
BINDINGS of the DEAD EYES.										
Those of the main and fore channels, *diameter*	0	1⅝	0	1½	0	1¼	0	1⅜	0	1
Mizen channel and topmast backstays.........	0	1¼	0	1⅜	0	1	0	0¾	0	0¾
Main and fore chains (or plates) *size of the iron*	0	1⅝	0	1½	0	1¼	0	1⅜	0	1
Diameter of the chain bolts	0	2⅛	0	2	0	1⅜	0	1⅜	0	1¼
Diameter of the preventer bolts	0	1⅝	0	1½	0	1⅜				
Mizen chains and backstays (or plates) *size of the iron*.................	0	1⅜	0	1¼	0	1				
Diameter of their chain bolts	0	1⅝	0	1⅜	0	1				
And driven below the channel	3	6	3	0	2	6				
Preventer eye-bolts between the chain-bolts to the main and fore...	*six*		*five*		*three*		*two*		*two*	
diameter	0	1⅝	0	1½	0	1¼	0	1	0	1
eyes in the clear	0	3¾	0	3½	0	2¾	0	2¼	0	2
Preventer eye-bolts to the mizen chains, *number* ..	*three*		*three*		*two*					
diameter	0	1⅝	0	1⅜	0	1				
eyes in the clear	0	2½	0	2¼	0	2				
Swivel Ring-Bolts, two in each channel, *diameter*	0	1	0	0⅞	0	0¾	0	0¾	0	0¾
eyes in the clear	0	2½	0	2¼	0	2	0	1¾	0	1¾
Eye-bolt driven in the side close before the fore channel for studding sail boom										
diameter	0	1⅜	0	1¼	0	1				
eye in the clear ..	0	2	0	1¾	0	1¼				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
OUTBOARD—*continued.*										
SHANKPAINTER CHAINS.—One on each side .... *in length*	13	6	11	6	9	6	7	6	7	0
Links in diameter...	0	1	0	0⅞	0	0¾	0	0⅝	0	0½
Bolt in diameter	0	1¼	0	1⅛	0	1	0	0¾	0	0¾
CHESTREES.—One on each side *sided*	0	10	0	8	0	5½				
Moulded at the upper part	0	8	0	6	0	3½				
Taper at the heel to......	0	3	0	2	0	1½				
To have a sheave or roller in the head ... *diameter*	0	9	0	7	0	4½				
in thickness	0	4	0	3	0	2½				
To be fixed *where the main yard arm plumbs with the side when braced sharp.*										
Bolted there with bolts *in number*	*four*		*three*		*three*					
diameter	0	1	0	0⅞	0	0¼				
RAILS and DRIFTS.—The upper edge of the sheer-rail to sheer agreeable to the top timber line, and to be above the upper edge of the rabbet of the keel .... *afore* ...	38	0	29	0	26	5	18	11	12	4
midship	35	4	27	0	22	10½	16	7	10	10
abaft ...	41	3	31	0	27	6	19	11	13	5
Upper edge of the waist rail below the upper edge of the sheer rail, and parallel thereto.	2	3	1	10	1	6	1	1	0	10
Upper edge of the channel rail below the upper edge of the sheer rail and parallel thereto.										
Upper edge of the drift rail above the upper edge of the sheer rail..										
forward	1	9	1	4						
aft.....	2	4	1	1	1	3				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Two Decks. GUNS 74		Frigate. GUNS 36		Merchant Ship. TONS 330		Brig. TONS 170		Sloop. TONS 60	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
OUTBOARD—*continued.*										
Upper edge of the main drift above the upper edge of the sheer rail..	1	9	1	2						
Upper edge of fife rail above the upper edge of the drift rail and parallel thereto .... *aft*	1	6								
Underside of planksheer above the drift rail, or fife rail, and parallel thereto......... *forward*	0	9	0	6	0	11	0	6		
aft	2	6	0	6	0	9	0	6	0	4

N. B. The ornamental rails on the sides of merchant-ships are generally wrought from the solid plank. The planks wrought in wake of the rails are consequently thick enough to raise the mouldings.

A TABLE OF THE WEIGHT AND DIMENSIONS OF ANCHORS.

WEIGHT OF ANCHORS	71 *cwt.*		40 *cwt.*		18 *cwt.*		6 *cwt.*		7 *cwt.*	
ANCHOR STOCKS, in *number*... *large*	*four*		*four*		*two*		*one*		*one*	
small	*two*		*two*		*two*		*two*		*onc*	
length	20	0	17	0	12	6	10	0	8	6
Square at the { *middle*	1	8	1	4½	1	0½	0	10	0	8½
Square at the { *ends* ..	0	10	0	8¼	0	6¼	0	5	0	4¾
Opening left between the pieces in the middle...	0	1¼	0	1	0	1	0	0⅞	0	0⅞
Bolted with four bolts, in *diameter*	0	1⅛	0	1	0	0¾	0	0¾	0	0¾
Hooped with iron.										
Four hoops to each, *thick*	0	0¾	0	0⅝	0	0½	0	0½	0	0⅜
broad	0	3¼	0	3	0	2½	0	2¼	0	2

TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

PARTICULARS, &c.	SPECIES.	LONG-BOATS.										LAUNCHES.								BARGE.	
	LENGTHS.	*Feet* 32		*Feet* 30		*Feet* 26		*Feet* 22		*Feet* 19		*Feet* 36		*Feet* 33		*Feet* 30		*Feet* 24		*Feet* 37	
		ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Benches	Broad	1	0	1	0	1	0	0	11	0	11	1	0	1	0	1	0	1	0	1	0
	Thick	0	1½	0	1½	0	1½	0	1¼	0	1¼	0	1½	0	1½	0	1½	0	1½	0	1¼
Deadwood	Sided	0	3½	0	3¼	0	2¾	0	2¼	0	2	0	4½	0	4	0	3½	0	3	0	3
Bottom	Thick	0	1⅛	0	1⅛	0	1⅛	0	1	0	0⅞	0	1½	0	1¼	0	1⅛	0	0⅞	0	0⅞
Landing, Strake	Broad	0	11	0	10½	0	9½	0	9	0	8¾	0	11	0	10	0	9	0	8	0	6½
Upper Strake	Broad	1	0	0	11½	0	10	0	9	0	8	1	0	0	11	0	10	0	9	0	6½
Gunwale	Deep	0	3¾	0	3½	0	3	0	2½	0	2¼	0	4¼	0	4¼	0	3¼	0	3	0	3¼
	Thick	0	4	0	3¾	0	3¼	0	2¾	0	2	0	4	0	4	0	3½	0	3¼	0	1¼
Breasthook	Sided	0	3½	0	3	0	2½	0	2¼	0	2	0	4	0	4	0	3½	0	3	0	1¾
	Length	4	6	4	2	3	6	3	3	2	10	5	0	4	3	3	9	3	0	2	6
	Moulded at the throat	0	7	0	6	0	5	0	4½	0	4	0	10	0	9	0	7	0	5	0	4
Ears	Sided	0	3¾	0	3½	0	3¼	0	3	0	2½	0	4	0	3¾	0	3½	0	3	0	1¼
	Length	1	9	1	8	1	6	1	4	1	2	2	0	1	10	1	9	1	6	0	11
Chocks	Thick	0	3¼	0	3	0	2¼	0	2½	0	2	0	4½	0	3½	0	3	0	2½	0	1½
	Length	1	6	1	5	1	4	1	2	1	1	3	0	2	9	1	4	1	2	1	2

Washboards	Broad { Bow quarter	0 7	0 7	0 7	0 6	0 5¼	0 6	0 6	0 6	0 6	{ 0 4½ 0 5½
Bowsprit Step	Thick	0 3	0 3	0 2½	} iron.	iron					
	Broad	1 2½	1 2	1 0							
Windlass	Diameter	0 10	0 9½	0 9	8	0 7	0 11	0 10	0 9	0 8	
Chocks	Thick	0 6	0 5½	0 5	4½	0 4	0 6½	0 6	0 5½	0 5	
	Broad	0 11	0 11	0 10	0 9	0 9	1 3	1 2	1 0	0 11	
Rudder	Breadth at the heel	2 0	1 10	1 8	1 7	1 6	2 0	1 10	1 9	1 7	1 7
	Breadth at the hance	1 4½	1 3½	1 2	1 1	1 0½	1 6	1 4	1 3	1 1½	1 3
	Breadth at the head	0 9	0 8½	0 8	0 7½	0 7	0 10	0 9	0 9	0 8	0 9
	Thickness	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1⅜	0 1½	0 1½	0 1½	0 1⅛

TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

[illegible]LARS, &c. — SPECIES.	LONG-BOATS.					LAUNCHES.				BARGE.
LENGTHS.	Feet 32	Feet 30	Feet 26	Feet 22	Feet 19	Feet 36	Feet 33	Feet 30	Feet 24	Feet 37
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
[illegible]	1 0	1 0	1 0	0 11	0 11	1 0	1 0	1 0	1 0	1 0
[illegible]	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1½	0 1½	0 1½	0 1½	0 1¼
[illegible]d	0 3½	0 3¼	0 2¾	0 2¼	0 2	0 4½	0 4	0 3½	0 3	0 3
[illegible]ack	0 1⅛	0 1⅛	0 1⅛	0 1	0 0⅞	0 1½	0 1¼	0 1⅛	0 0⅞	0 0⅞
[illegible]road	0 11	0 10½	0 9½	0 9	0 8¾	0 11	0 10	0 9	0 8	0 6½
[illegible]nd	1 0	0 11½	0 10	0 9	0 8	1 0	0 11	0 10	0 9	0 6½
[illegible]p	0 3¾	0 3½	0 3	0 2½	0 2¼	0 4¼	0 4¼	0 3¼	0 3	0 3¾
[illegible]ck	0 4	0 3¾	0 3¼	0 2¾	0 2	0 4	0 4	0 3½	0 3¼	0 1¼
[illegible]d	0 3½	0 3	0 2½	0 2¼	0 2	0 4	0 4	0 3½	0 3	0 1¾
[illegible]ngth	4 6	4 2	3 6	3 3	2 10	5 0	4 3	3 9	3 0	2 6
Moulded at the throat	0 7	0 6	0 5	0 4½	0 4	0 10	0 9	0 7	0 5	0 4
Sided	0 3¾	0 3½	0 3¼	0 3	0 2½	0 4	0 3¼	0 3½	0 3	0 1¾
Length	1 9	1 8	1 6	1 4	1 2	2 0	1 10	1 9	1 6	0 11
Thick	0 3¼	0 3	0 2¾	0 2½	0 2	0 4½	0 3½	0 3	0 2½	0 1½
Length	1 6	1 5	1 4	1 2	1 1	3 0	2 9	1 4	1 2	1 2

Washboards	Broad	Bow quarter	0 7	0 7	0 7	0 6	0 5¼	0 6	0 6	0 6	0 6	0 4½ / 0 5½
Bowsprit Step	Thick		0 3	0 3	0 2½	iron.	iron					
	Broad		1 2½	1 2	1 0							
Windlass	Diameter		0 10	0 9½	0 9	8	0 7	0 11	0 10	0 9	0 8	
Chocks	Thick		0 6	0 5½	0 5	4½	0 4	0 6½	0 6	0 5½	0 5	
	Broad		0 11	0 11	0 10	0 9	0 9	1 3	1 2	1 0	0 11	
Rudder	Breadth at the heel		2 0	1 10	1 8	1 7	1 6	2 0	1 10	1 9	1 7	1 7
	Breadth at the hance		1 4¼	1 3½	1 2	1 1	1 0½	1 6	1 4	1 3	1 1½	1 3
	Breadth at the head		0 9	0 8½	0 8	0 7½	0 7	0 10	0 9	0 9	0 8	0 9
	Thickness		0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1⅛	0 1½	0 1½	0 1½	0 1⅛

A TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

PARTICULARS, &c.	SPECIES.	PINNACES.								CUTTERS.								YAWLS.				Wherry.	
	LENGTHS.	Feet 32		Feet 28		Feet 25		Feet 17		Feet 30		Feet 25		Feet 21		Feet 16		Feet 26		Feet 16		Feet 25	
		ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
BREADTH	Moulded	7	6	6	10	6	0	5	9	7	0	6	10	6	7	6	0	6	8	5	6	5	11
DEPTH	in midships	3	3	3	0	2	7	2	5	2	10	2	8	2	6	2	3	2	11	2	3½	2	4
	afore	4	0	3	8	3	2	2	11	3	8	3	3	3	1	2	9	3	6	2	9	3	0½
	abaft	4	4	4	0	3	5	3	2	3	9	3	4	3	1	2	9	3	9	2	11	2	11½
KEEL	Sided in midships	0	4½	0	4	0	3¾	0	3½	0	4	0	3¾	0	3½	0	3	0	3¾	0	3¼	0	3¼
	Deep below the rabbet	0	5	0	4½	0	4	0	4	0	4	0	3½	0	3¼	0	2¾	0	3	0	2¾	0	3½
	To be above the rabbet for Deadwood	0	1	0	0⅞	0	0⅞	0	0¾	0	1	0	0⅞	0	0¾	0	0¾	0	0¾	0	0¾	0	0¾
STEM	Sided	0	4	0	3¾	0	3½	0	3¼	0	3½	0	3¼	0	3	0	2¾	0	3¼	0	2¾	0	2½
	Afore the rabbet at the head	0	3¾	0	3½	0	3¼	0	3	0	5	0	4¾	0	4½	0	4	0	4½	0	4	0	3½
	Abaft the rabbet	0	2½	0	2½	0	2¼	0	2⅛	0	1½	0	1⅝	0	1¼	0	1¼	0	1¼	0	1⅛	0	1¼
TRANSOM	Broad or moulded at the upper part	4	7	4	0	3	6	3	0	3	3	3	1	2	10	2	4	3	8	2	7	1	6
	Thick, or sided	0	2½	0	2¼	0	2	0	1¾	0	1¾	0	1½	0	1½	0	1¼	0	1¾	0	1½	0	1½
	Knees, sided	*iron*		*iron*		*iron*		*iron*		0	1¾	0	1½	0	1½	0	1¼	*iron*		*iron*		*iron*	

STERN-POST	Sided at the tuck	0 3½	0 3¼	0 3	0 2¾	0 3	0 2⅞	0 2¾	0 2½	0 2⅝	0 2¼	0 2¾
	at the keel	0 3	0 2¾	0 2½	0 2⅜	0 2½	0 2½	0 2⅜	0 2	0 2¼	0 1¾	0 2¼
	Broad, or fore and aft at the keel	0 11	0 10	0 9¼	0 8½	0 9	0 9	0 8½	0 7	0 8¾	0 7	0 8
	(*Transom included*) at the head	0 2¾	0 2½	0 2¼	0 2	0 4	0 4	0 3¾	0 3	0 2	0 1½	0 3¼
FLOOR-TIMBERS	Sided	0 1¾	0 1⅝	0 1½	0 1⅜	0 1¾	0 1½	0 1⅜	0 1¼	0 1¾	0 1½	0 1
	Moulded at the head	0 1¾	0 1⅝	0 1⅜	0 1¼	0 1⅝	0 1¼	0 1¼	0 1⅛	0 1⅝	0 1½	0 1¼
	at the throat	0 4	0 3¾	0 3⅝	0 3½	0 3.	0 2¾	0 2⅜	0 2	0 3½	0 3	0 2¾
FUTTOCKS	Sided at the heels	0 1½	0 1½	0 1⅜	0 1¼	0 1½	0 1⅜	0 1¼	0 1⅛	0 1½	0 1¼	0 1
	at the heads	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1¼	0 1⅛	0 1
	Moulded at the heads	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1¼	0 1⅛	0 1
	Scarph of the timbers	1 10	1 9	1 8	1 7	2 0	1 10	1 9	1 7	1 10	1 8	1 8
KEELSON	*Broad*	0 11	0 11	0 10½	0 10	0 10	0 9½	0 9½	0 8	0 10	0 9	0 10
	Thick	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1⅜	0 1	0 1⅛
FOOTWALING	*Thick*	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾
RISING	*Broad*	0 4½	0 4½	0 4⅜	0 4	0 4	0 4	0 3¾	0 3½	0 6	0 5	0 3½
	Thick	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 1	0 1	0 0⅞
THWARTS	Main *Broad*	0 10	0 10	0 9½	0 9	0 10	0 9	0 8	0 7	0 10	0 9	0 9¼
	Main *Thick*	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1⅜	0 1¾	0 1⅝	0 1¼
	After *Broad*	0 9	0 9	0 8½	0 8	0 8	0 8	0 8	0 7	0 7½	0 7	0 7½
	After *Thick*	0 1¾	0 1¾	0 1⅝	0 1½	0 1¾	0 1¾	0 1¾	0 1½	0 1½	0 1½	0 1¼
	Fore *Broad*	0 8	0 8	0 7½	0 7	0 10	0 10	0 10	0 9	0 7½	0 7	0 8½
	Fore *Thick*	0 8½	0 1½	0 1⅜	0 1⅜	0 2	0 2	0 2	0 1¾	0 1½	0 1½	0 1⅜
	Loose *Broad*	0 8	0 8	0 7½	0 7	0 8	0 8	0 8	0 7	0 7½	0 7	0 7½
	Loose *Thick*	0 1½	0 1½	0 1⅜	0 1¼	0 1⅜	0 1½	0 1½	0 1½	0 1½	0 1½	0 1¼
	Knees upon the thwarts, *sided*	*iron*	*iron*	*iron*	*iron*	0 1¼	0 1⅛	0 1⅛	0 1	*iron*	*iron*	*iron*

TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

PARTICULARS, &c.	SPECIES.	PINNACES.								CUTTERS.								YAWLS.				Wherry.	
	LENGTHS.	Feet 32		Feet 28		Feet 25		Feet 17		Feet 30		Feet 25		Feet 21		Feet 16		Feet 26		Feet 16		Feet 25	
		ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
BENCHES	Broad	1	0	0	11	0	11	0	10	1	0	0	11	0	11	0	10	0	11	0	10	1	0
	Thick	0	1¼	0	1¼	0	1⅛	0	1⅛	0	1¼	0	1¼	0	1¼	0	1⅛	0	1¼	0	1⅛	0	1⅛
DEADWOOD	Sided	0	3	0	2¾	0	2½	0	2½	0	2¼	0	2½	0	2½	0	2	0	2¼	0	2	0	2
BOTTOM	Thick	0	0⅞	0	0⅞	0	0⅞	0	0⅞	0	0¼	0	0¾	0	0⅝	0	0⅝	0	0⅞	0	0⅞	0	0¾
LANDING STRAKE	Broad	0	6½	0	6½	0	6½	0	5	0	5½	0	5	0	4½	0	4	0	8	0	7½	0	6
UPPER STRAKE	Broad	0	6½	0	6½	0	6½	0	5½	0	6	0	6	0	5	0	4½	0	8	0	7½	0	6½
GUNWALE	Deep	0	3¾	0	3½	0	3½	0	3¼	0	2	0	1¾	0	1½	0	1½	0	2½	0	2¼	0	3¼
	Thick	0	1⅝	0	1½	0	1½	0	1½	0	2½	0	2¼	0	2	0	2	0	2	0	1¾	0	1½
BREASTHOOK	Sided	0	1¾	0	1½	0	1½	0	1⅜	0	2¼	0	2	0	1¾	0	1½	0	2	0	1¾	0	1½
	Length	2	4	2	2	2	0	1	8	1	9	1	8	1	7	1	6	2	4	2	2	2	0
	Moulded at the throat	0	4	0	4	0	3½	0	3	0	3½	0	3	0	2¾	0	2½	0	3½	0	3	0	3
EARS	Sided	0	1¾	0	1⅝	0	1½	0	1½	0	1⅝	0	1½	0	1¼	0	1¼	0	2	0	1¾	0	1½
	Length	0	10	0	10	0	10	0	10	1	4	1	2	0	11	0	9	1	0	0	11	0	10
CHOCKS	Thick	0	1½	0	1¼	0	1¼	0	1¼	0	1½	0	1¼	0	1¼	0	1¼	0	1¼	0	1½	0	1¼
	Length	1	2	1	1	1	0	0	11	1	3	1	2	1	0	0	11	1	1	1	0	0	11

WASHBOARDS	Broad	Bow quar-	0 4½	0 4½	0 4	0 3½	5 0	5 0	0 4¼	0 4½	0 4½	0 4½	0 4½
		ter	0 5½	0 5½	0 5	0 4½					0 5½	0 5½	0 5½
RUDDER	Breadth at the heel		1 6	1 5	1 3	1 1	1 6	1 4	1 2½	1 1	1 5	1 3	1 3
	Breadth at the hance		1 2	1 1	1 0	0 10	1 2	1 1	1 0	0 10	1 0½	0 11	0 11
	Breadth at the head		0 8	0 7½	0 7½	0 7½	0 7	0 7	0 6½	0 6	0 7	0 6	0 5
	Thickness		0 1	0 1	0 1	0 0⅞	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞

ERRATA.

Page 82, line 29, *for* posts *read* ports.
—— 83, —— 19 and 26, *erase* "Inboard Works, Plate IV."
—— 84, last line but one, *erase* "Midship Section, Plate IV."
—— 85, in the Article "Binding Strakes," *for* Plate IV. *read* III.
—— 89, line 3, *erase* the reference.
—— 91, last line but one, *read* "Plate IV."
—— 92, line 24, from the bottom, *for* croak *read* crook.
—— 116, —— 18, *for* luffer, *read* luff or.
—— 118, *for* mimtons, *read* muntins.
—— 129, line 18, *for* spinal *read* spiral.
—— 133, *for* spirkitting *read* spirketting.
—— 137, *for* tasking of plank *read* tasting.
—— 146, line 17, from the bottom, *read* "weatherly."
—— 162 and 163, *for* folio I. *read* p. 266.
—— 177, line 30, *for* stern *read* stem.
—— 211, —— 19, from the bottom, *read* "lowered."
—— 219, —— 3, from the bottom, *for* heeling *read* keeling."
—— 221, —— 5, from the bottom, *for* Arcs *read* Diagonals.
—— 223, —— 15, *for* firm *read* trim.
—— 230, —— 31, 41, and 47, and page 231, lines 5 and 14, *read* D *for* F.
—— 231, lines 16, 15, and 14, from the bottom, *for* 8 *read* 7.
—— 235, —— 13, *for* hook *read* hoop.
—— 238, —— 4, *for* capped *read* lapped.
—— 242, —— 4, from the bottom, *for* trace *read* place.
—— 243, —— 10 from the bottom, *insert* the word, "inches."

DIMENSIONS OF BODIES.

—— 291, article 11, *for* 18 3 *read* 17 6.
—— 318, line 1, *for* length *read* beams.
—— 319, —— 1, *for* cathead *read* knees.
—— 335, Weight of Anchors, line 1, col. 4, *for* 6 *read* 9.

ADDENDA.

The two following were accidently omitted in the Tables of Dimensions.
Page 256, line 5, col. 2, *insert* 37 10.
—— 299, col. 2, Diameter of the Scuppers along the sides, 4 inches.

C. WHITTINGHAM, PRINTER, DEAN STREET.

NEW AND INTERESTING

PUBLICATIONS

ON

NAVAL ARCHITECTURE, MAST-MAKING, RIGGING, &c.

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THE

ELEMENTS AND PRACTICE

OF

NAVAL ARCHITECTURE:

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We have already noticed, in the preface to the present volume, that the above work developes, most fully, the principles of Ship-building, both *theoretical* and *practical:* that it describes, at large, all the various experiments which have been made for ascertaining the resistance of floating bodies, and the true theory thence arising. The practical parts of the subject are also, in their different ramifications, most fully and clearly described; particularly the subject of Laying-off in the Mould-Loft, which, from its nature, will not admit of a copious and adequate discussion in a small treatise; this subject being illustrated with a particular series of large draughts, which exhibit, in the plainest manner ever yet seen, the arcana of this very important and essential branch of the art.

In order, however, to give the reader a more satisfactory idea of the nature and value of this work, we annex the following abstract of its contents.

TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

PARTICULARS, &c.	SPECIES.	LONG-BOATS.										LAUNCHES.								BARGE.	
	LENGTHS.	*Feet* 32		*Feet* 30		*Feet* 26		*Feet* 22		*Feet* 19		*Feet* 36		*Feet* 33		*Feet* 30		*Feet* 24		*Feet* 37	
		ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
BREADTH	Moulded	9	6	9	3	8	9	7	6	7	1	10	6	9	9	9	0	7	10	7	9
DEPTH	in midships	4	3	4	1	3	8	3	6	2	10	4	3	4	0	3	10	3	3	3	0
	afore	5	6	5	4	4	9	4	2	3	3	5	0	4	9	4	6	3	9	3	10
	abaft	5	7	5	5	4	10	4	3	3	4	5	0	4	9	4	6	3	9	4	3
KEEL	Sided in midships	0	5½	0	5	0	4¼	0	4⅜	0	3¾	0	7	0	6½	0	6	0	5½	0	4¼
	Deep below the rabbet	0	6½	0	6	0	5¾	0	5½	0	5	0	5	0	5	0	5	0	4½	0	5
	To be above the rabbet for Deadwood	0	1¼	0	1	0	0⅞	0	0¾	0	0¾	0	0½	0	1¼	0	1¼	0	1	0	1
STEM	Sided	0	4½	0	4	0	3⅞	0	3½	0	3½	0	5¼	0	5⅛	0	5	0	4¾	0	4
	Afore the rabbet at the head	0	7	0	6½	0	6	0	5½	0	5	0	5¼	0	5⅛	0	5	0	4½	0	3½
	Abaft the rabbet	0	1¾	0	1¼	0	1⅝	0	1⅜	0	1⅜	0	2¼	0	2½	0	2½	0	2	0	2½
TRANSOM	Broad or moulded at the upper part	5	11	5	8	5	3	3	9	3	4	9	0	8	3	7	6	6	6	4	9
	Thick, or sided	0	4	0	4	0	3½	0	3	0	2¼	0	4	0	3¾	0	3½	0	3	0	2½
	Knees, sided	0	3½	0 -	3½	0	3¼	0	2¼	0	2	0	4	0	3¾	0	3½	0	3	*iron.*	

STERN-POST	Sided at the tuck	0 4¼	0 4¼	0 3¾	0 3¼	0 3	0 5½	0 5¼	0 5	0 4¼	0 3¾
	at the keel	0 3½	0 3¼	0 2¾	0 2⅝	0 2½	0 5½	0 5¼	0 5	0 4¼	0 3¼
	Broad, or fore and aft at the keel	1 4	1 2	1 1	1 0	0 10	1 1	1 0	0 11	0 10	0 11½
	(Transom included) at the head	0 8¼	0 7½	0 6¾	0 5	0 4½	0 6¼	0 6	0 5¾	0 5¼	0 3
FLOOR-TIMBERS	Sided	0 3	0 3	0 2¾	0 2½	0 1¼	0 4	0 3½	0 2¾	0 2¼	0 1¾
	Moulded at the head	0 3	0 3	0 2½	0 2¼	0 1⅝	0 3¾	0 3½	0 2¾	0 2¼	0 1¾
	at the throat	0 5¼	0 5	0 4½	0 4¼	0 3¾	0 6	0 5½	0 5	0 4½	0 4
FUTTOCKS	Sided at the heels	0 3	0 2¾	0 2½	0 2⅛	0 1¾	0 4	0 3¾	0 3	0 2	0 1¾
	at the heads	0 2¾	0 2½	0 2	0 1⅞	0 1½	0 3½	0 3¼	0 2½	0 1½	0 1¼
	Moulded at the heads	0 2¾	0 2½	0 2	0 1⅞	0 1½	0 3½	0 3¼	0 2½	0 1½	0 1¼
	Scarph of the timbers	3 0	2 10	2 4	2 0	1 10	3 0	2 9	2 6	2 2	2 0
KEELSON	*Broad*	1 1	1 0	1 0	0 11	0 10½	1 2	1 1	1 0	0 10	0 11
	Thick	0 3	0 3	0 2½	0 1¾	0 1½	0 3	0 2¾	0 2½	0 2	0 1¼
FOOTWALING	*Thick*	0 1¼	0 1¼	0 1	0 1	0 1	0 1½	0 1¼	0 1¼	0 1	0 0¾
RISING	*Broad*	0 10	0 10	0 9	0 8	0 6½	0 11	0 10	0 8½	0 7	0 4½
	Thick	1 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1¼	0 1⅛	0 1	0 0⅞
THWARTS	Main *Broad*	1 0	0 11	0 11	0 10	0 10	1 1	1 0	0 11	0 10	0 10
	Main *Thick*	0 4	0 3¾	0 3½	0 3¼	0 3	0 4	0 3¼	0 3½	0 3¼	0 1½
	After *Broad*	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 9
	After *Thick*	0 2½	0 2½	0 2½	0 2¼	0 2	0 2½	0 2½	0 2¼	0 2	0 1¾
	Fore *Broad*	0 10	0 10	0 10	0 10	0 10	0 9	0 9	0 9	0 9	0 8
	Fore *Thick*	0 2¾	0 2¾	0 2¾	0 2½	0 2¼	0 2¼	0 2½	0 2¼	0 2	0 8½
	Loose *Broad*	0 9	0 9	0 8	0 8	0 8	0 9	0 9	0 9	0 9	0 8
	Loose *Thick*	0 2	0 2	0 2	0 1¾	0 1½	0 2½	0 2½	0 2¼	0 2	0 1½
	Knees upon the thwarts, *sided*	0 3	0 3	0 2¾	0 2½	0 2¼	0 4	0 3¾	0 3½	0 3	*iron*

TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

PARTICULARS, &c.	SPECIES.	LONG-BOATS.										LAUNCHES.								BARGE.	
	LENGTHS.	Feet 32		Feet 30		Feet 26		Feet 22		Feet 19		Feet 36		Feet 33		Feet 30		Feet 24		Feet 37	
		ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
BENCHES	Broad	1	0	1	0	1	0	0	11	0	11	1	0	1	0	1	0	1	0	1	0
	Thick	0	1½	0	1½	0	1½	0	1¼	0	1¼	0	1½	0	1½	0	1½	0	1½	0	1¼
DEADWOOD	Sided	0	3½	0	3¼	0	2¾	0	2¼	0	2	0	4½	0	4	0	3½	0	3	0	3
BOTTOM	Thick	0	1⅛	0	1⅛	0	1⅛	0	1	0	0⅞	0	1½	0	1¼	0	1⅛	0	0⅞	0	0⅞
LANDING, STRAKE	Broad	0	11	0	10½	0	9½	0	9	0	8¾	0	11	0	10	0	9	0	8	0	6½
UPPER STRAKE	Broad	1	0	0	11½	0	10	0	9	0	8	1	0	0	11	0	10	0	9	0	6½
GUNWALE	Deep	0	3¾	0	3½	0	3	0	2½	0	2¼	0	4¼	0	4¼	0	3¼	0	3	0	3¾
	Thick	0	4	0	3¼	0	3¼	0	2¾	0	2	0	4	0	4	0	3½	0	3¼	0	1¾
BREASTHOOK	Sided	0	3½	0	3	0	2½	0	2¼	0	2	0	4	0	4	0	3½	0	3	0	1¾
	Length	4	6	4	2	3	6	3	3	2	10	5	0	4	3	3	9	3	0	2	6
	Moulded at the throat	0	7	0	6	0	5	0	4½	0	4	0	10	0	9	0	7	0	5	0	4
EARS	Sided	0	3¾	0	3½	0	3¼	0	3	0	2½	0	4	0	3¾	0	3½	0	3	0	1¾
	Length	1	9	1	8	1	6	1	4	1	2	2	0	1	10	1	9	1	6	0	11
CHOCKS	Thick	0	3¼	0	3	0	2¾	0	2½	0	2	0	4½	0	3½	0	3	0	2½	0	1½
	Length	1	6	1	5	1	4	1	2	1	1	3	0	2	9	1	4	1	2	1	2

WASHBOARDS	Broad { Bow quarter	0 7	0 7	0 7	0 6	0 5¼	0 6	0 6	0 6	0 6	{ 0 4½ 0 5½
BOWSPRIT STEP	Thick	0 3	0 3	0 2½	} iron.	iron					
	Broad	1 2½	1 2	1 0							
WINDLASS	Diameter	0 10	0 9½	0 9	8	0 7	0 11	0 10	0 9	0 8	
CHOCKS	Thick	0 6	0 5½	0 5	4½	0 4	0 6½	0 6	0 5½	0 5	
	Broad	0 11	0 11	0 10	0 9	0 9	1 3	1 2	1 0	0 11	
RUDDER	Breadth at the heel	2 0	1 10	1 8	1 7	1 6	2 0	1 10	1 9	1 7	1 7
	Breadth at the hance	1 4¼	1 3½	1 2	1 1	1 0½	1 6	1 4	1 3	1 1½	1 3
	Breadth at the head	0 9	0 8½	0 8	0 7½	0 7	0 10	0 9	0 9	0 8	0 9
	Thickness	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1⅜	0 1½	0 1½	0 1½	0 1⅜

A TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

PARTICULARS, &c.	SPECIES.	PINNACES.				CUTTERS.				YAWLS.		Wherry.
	LENGTHS.	*Feet* 32	*Feet* 28	*Feet* 25	*Feet* 17	*Feet* 30	*Feet* 25	*Feet* 21	*Feet* 16	*Feet* 26	*F eet* 16	*Feet* 25
		ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
BREADTH	Moulded	7 6	6 10	6 0	5 9	7 0	6 10	6 7	6 0	6 8	5 6	5 11
DEPTH	in midships	3 3	3 0	2 7	2 5	2 10	2 8	2 6	2 3	2 11	2 3½	2 4
	afore	4 0	3 8	3 2	2 11	3 8	3 3	3 1	2 9	3 6	2 9	3 0½
	abaft	4 4	4 0	3 5	3 2	3 9	3 4	3 1	2 9	3 9	2 11	2 11½
KEEL	Sided in midships	0 4½	0 4	0 3¾	0 3½	0 4	0 3¾	0 3½	0 3	0 3¾	0 3¾	0 3¾
	Deep below the rabbet	0 5	0 4½	0 4	0 4	0 4	0 3½	0 3¾	0 2¾	0 3	0 2¾	0 3½
	To be above the rabbet for Deadwood	0 1	0 0⅞	0 0⅞	0 0¾	0 1	0 0⅞	0 0¾	0 0¾	0 0¼	0 0¼	0 0¾
STEM	Sided	0 4	0 3¼	0 3½	0 3¼	0 3½	0 3¼	0 3	0 2¾	0 3¼	0 2¾	0 2½
	Afore the rabbet at the head	0 3¾	0 3½	0 3¼	0 3	0 5	0 4¾	0 4½	0 4	0 4½	0 4	0 3½
	Abaft the rabbet	0 2½	0 2½	0 2¼	0 2⅛	0 1½	0 1⅛	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼
TRANSOM	Broad or moulded at the upper part	4 7	4 0	3 6	3 0	3 3	3 1	2 10	2 4	3 8	2 7	1 6
	Thick, or sided	0 2½	0 2¼	0 2	0 1¾	0 1¼	0 1½	0 1½	0 1¼	0 1¾	0 1½	0 1½
	Knees, sided	*iron*	*iron*	*iron*	*iron*	0 1¾	0 1½	0 1½	0 1¼	*iron*	*iron*	*iron*

STERN-POST	Sided at the tuck	0 3½	0 3¼	0 3	0 2¾	0 3	0 2⅞	0 2¾	0 2½	0 2⅝	0 2¼	0 2¾
	at the keel	0 3	0 2¾	0 2½	0 2⅜	0 2½	0 2½	0 2⅜	0 2	0 2¼	0 1¾	0 2¼
	Broad, or fore and aft at the keel	0 11	0 10	0 9¼	0 8½	0 9	0 9	0 8½	0 7	0 8¾	0 7	0 8
	(Transom included) at the head	0 2¾	0 2½	0 2¼	0 2	0 4	0 4	0 3¾	0 3	0 2	0 1½	0 3¼
FLOOR-TIMBERS	Sided	0 1¾	0 1⅝	0 1½	0 1⅜	0 1¾	0 1½	0 1⅜	0 1¼	0 1¼	0 1½	0 1
	Moulded at the head	0 1¾	0 1⅝	0 1⅜	0 1¼	0 1⅝	0 1¼	0 1¼	0 1⅛	0 1⅝	0 1½	0 1¼
	at the throat	0 4	0 3¾	0 3⅝	0 3½	0 3	0 2¾	0 2⅜	0 2	0 3½	0 3	0 2¼
FUTTOCKS	Sided at the heels	0 1½	0 1½	0 1⅜	0 1¼	0 1½	0 1⅜	0 1¼	0 1⅛	0 1½	0 1¼	0 1
	at the heads	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1¼	0 1⅛	0 1
	Moulded at the heads	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1¼	0 1⅛	0 1
	Scarph of the timbers	1 10	1 9	1 8	1 7	2 0	1 10	1 9	1 7	1 10	1 8	1 8
KEELSON	*Broad*	0 11	0 11	0 10½	0 10	0 10	0 9½	0 9½	0 8	0 10	0 9	0 10
	Thick	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1⅛	0 1	0 1⅛
FOOTWALING	*Thick*	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾
RISING	*Broad*	0 4½	0 4½	0 4⅛	0 4	0 4	0 4	0 3¾	0 3½	0 6	0 5	0 3½
	Thick	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 1	0 1	0 0⅞
THWARTS	Main *Broad*	0 10	0 10	0 9½	0 9	0 10	0 9	0 8	0 7	0 10	0 9	0 9¼
	Main *Thick*	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1⅜	0 1¾	0 1⅝	0 1¼
	After *Broad*	0 9	0 9	0 8½	0 8	0 8	0 8	0 8	0 7	0 7½	0 7	0 7½
	After *Thick*	0 1¾	0 1¾	0 1⅝	0 1½	0 1¾	0 1¾	0 1¾	0 1½	0 1½	0 1½	0 1¼
	Fore *Broad*	0 8	0 8	0 7½	0 7	0 10	0 10	0 10	0 9	0 7½	0 7	0 8½
	Fore *Thick*	0 8½	0 1½	0 1⅜	0 1⅜	0 2	0 2	0 2	0 1¾	0 1½	0 1½	0 1⅜
	Loose *Broad*	0 8	0 8	0 7½	0 7	0 8	0 8	0 8	0 7	0 7½	0 7	0 7½
	Loose *Thick*	0 1½	0 1½	0 1⅜	0 1¼	0 1¾	0 1½	0 1½	0 1½	0 1½	0 1½	0 1¼
	Knees upon the thwarts, *sided*	*iron*	*iron*	*iron*	*iron*	0 1¼	0 1⅛	0 1⅛	0 1	*iron*	*iron*	*iron*

TABLE OF THE DIMENSIONS AND SCANTLINGS OF BOATS.

PARTICULARS, &c.	SPECIES.	PINNACES.								CUTTERS.								YAWLS.				Wherry.	
	LENGTHS.	Feet 32		Feet 28		Feet 25		Feet 17		Feet 30		Feet 25		Feet 21		Feet 16		Feet 26		Feet 16		Feet 25	
		ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
BENCHES	Broad	1	0	0	11	0	11	0	10	1	0	0	11	0	11	0	10	0	11	0	10	1	0
	Thick	0	1¼	0	1¼	0	1⅛	0	1⅛	0	1¼	0	1¼	0	1¼	0	1⅛	0	1¼	0	1⅛	0	1⅛
DEADWOOD	Sided	0	3	0	2¾	0	2½	0	2½	0	2¾	0	2½	0	2½	0	2	0	2¼	0	2	0	2
BOTTOM	Thick	0	0⅞	0	0⅞	0	0⅞	0	0⅞	0	0¾	0	0¾	0	0⅝	0	0⅝	0	0⅞	0	0⅞	0	0¾
LANDING STRAKE	Broad	0	6½	0	6½	0	6½	0	5	0	5½	0	5	0	4½	0	4	0	8	0	7½	0	6
UPPER STRAKE	Broad	0	6½	0	6½	0	6½	0	5½	0	6	0	6	0	5	0	4½	0	8	0	7½	0	6½
GUNWALE	Deep	0	3¾	0	3½	0	3½	0	3¼	0	2	0	1¾	0	1½	0	1½	0	2½	0	2¼	0	3¼
	Thick	0	1⅝	0	1½	0	1½	0	1½	0	2½	0	2¼	0	2	0	2	0	2	0	1¾	0	1½
BREASTHOOK	Sided	0	1¾	0	1½	0	1½	0	1⅜	0	2¼	0	2	0	1¾	0	1½	0	2	0	1¾	0	1½
	Length	2	4	2	2	2	0	1	8	1	9	1	8	1	7	1	6	2	4	2	2	2	0
	Moulded at the throat	0	4	0	4	0	3½	0	3	0	3½	0	3	0	2¾	0	2⅓	0	3½	0	3	0	3
EARS	Sided	0	1¾	0	1⅝	0	1½	0	1½	0	1⅝	0	1½	0	1¼	0	1¼	0	2	0	1¾	0	1½
	Length	0	10	0	10	0	10	0	10	1	4	1	2	0	11	0	9	1	0	0	11	0	10
CHOCKS	Thick	0	1½	0	1¼	0	1¼	0	1¼	0	1½	0	1¼	0	1¼	0	1¼	0	1¾	0	1½	0	1¼
	Length	1	2	1	1	1	0	0	11	1	3	1	2	1	0	0	11	1	1	1	0	0	11

WASHBOARDS	Broad	Bow quar-	0	4½	0	4½	0	4	0	3½	5	0	5	0	0	4¼	0	4½	0	4½	0	4½	0	4½
		ter	0	5½	0	5½	0	5	0	4½									0	5½	0	5½	0	5¼
RUDDER	Breadth at the heel		1	6	1	5	1	3	1	1	1	6	1	4	1	2½	1	1	1	5	1	3	1	3
	Breadth at the hance...........		1	2	1	1	1	0	0	10	1	2	1	1	1	0	0	10	1	0½	0	11	0	11
	Breadth at the head		0	8	0	7½	0	7½	0	7½	0	7	0	7	0	6½	0	6	0	7	0	6	0	5
	Thickness		0	1	0	1	0	1	0	0⅞	0	1	0	1	0	0⅞	0	0⅞	0	0⅞	0	0⅞	0	0⅞

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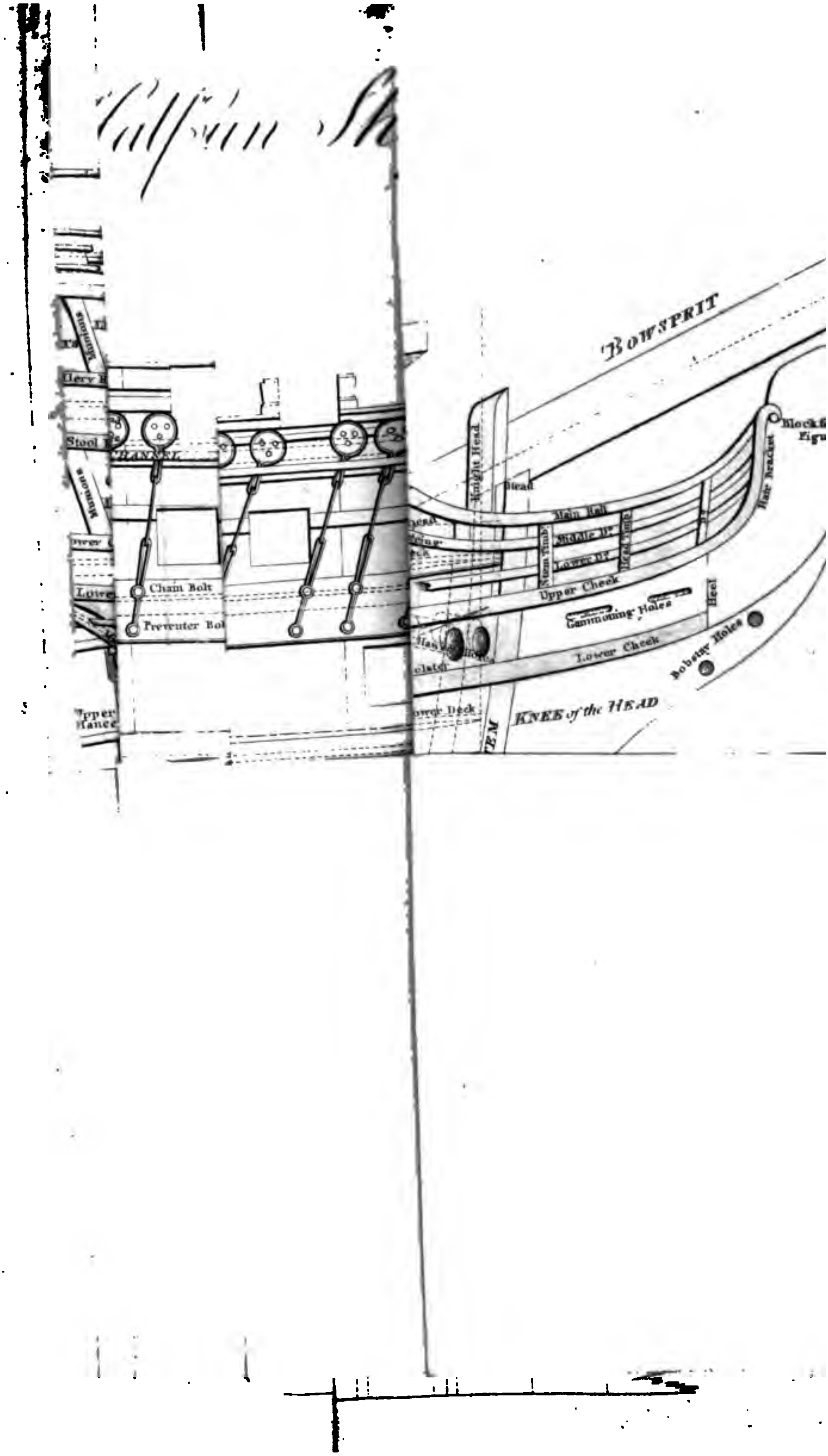
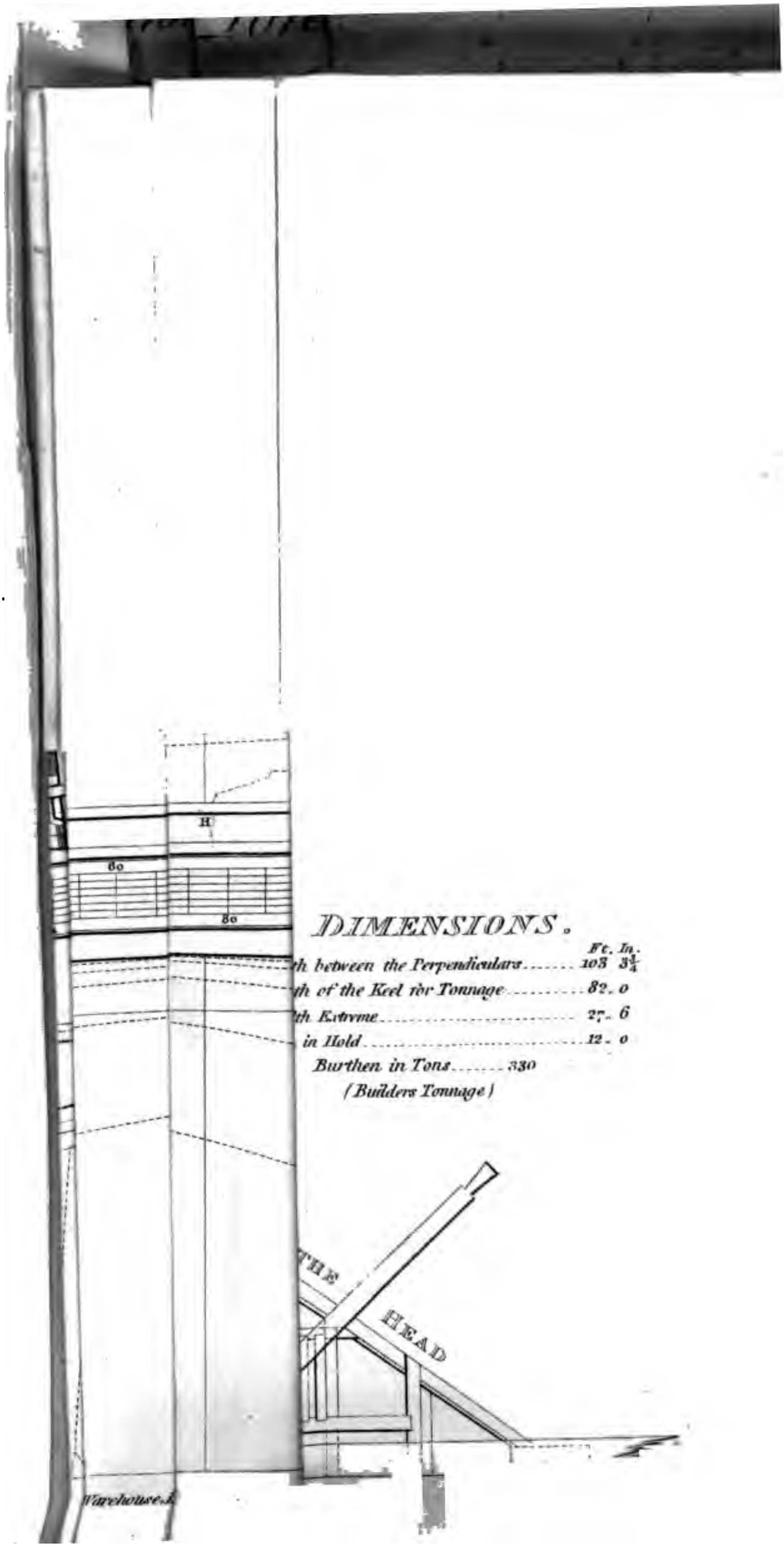


BOWSPRIT
CHANNEL
Chain Bolt
Knight Head
Main Rail
Middle Dº
Lower Dº
Stem Timb
Head Timb
Hair Bracket
Upper Cheek
Gammoning Holes
Heel
Lower Cheek
Bobstay Holes
KNEE of the HEAD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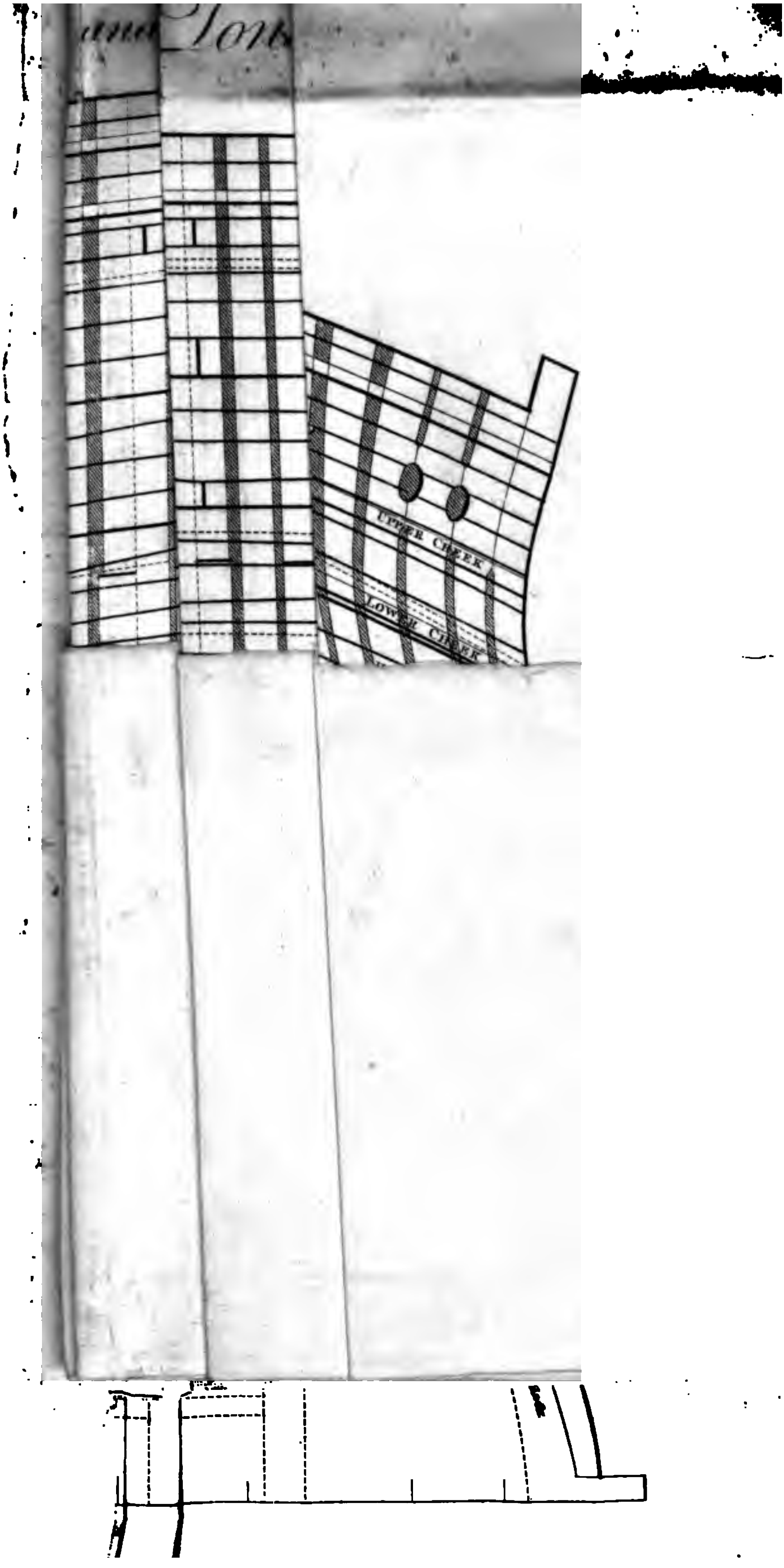
80
DIMENSIONS.
Ft. In.
th between the Perpendiculars....... 103 3¾
th of the Keel for Tonnage.......... 82. 0
th Extreme.......................... 27. 6
in Hold............................. 12. 0
Burthen in Tons....... 330
(Builders Tonnage)
THE
HEAD
Warehouse.


UPPER CHEEK
LOWER CHEEK