LUMBERMAN'S AND LOGGER'S GUIDE

FIRST 1919 EDITION

Lumberman's and

.˙. Logger's Guide .˙.

Merits and Uses of

Douglas Fir, California Redwood *and the* Leading Commercial Woods *of* *the* Pacific Coast

Rapid Methods of Computing Specifications, Contents and Weight of Squared and Tapering Lumber Octagon Spars and Logs

LOG TABLES

Log Scaling and Grading Rules

THE METRIC SYSTEM

Includes Conversion Tables and Informatian Relative to Foreign Export Cargo Shipments

TABLE OF DISTANCES

From Pacific Coast Ports to Foreign Ports also Inland Waters of Puget Sound Columbia River and British Columbia

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PREFACE

The object of the author in presenting this book to the public is to furnish reliable data pertaining to the merits and uses of Douglas Fir, California Redwood and Pacific Coast Forest Products.

The various subjects treated will save the Lumberman and Logger many hours of research, as the numerous problems covered cannot be solved without the practical and technical knowledge that can only be gained by a long and varied experience in both the Lumber and Shipping industries.

As Belgium, France Italy and Countries using the "Metric System" require lumber and specifications to conform to their standard, the writer has specialized on this subject, so as to enable shipowners and lumbermen to successfully cater to this trade, which will increase to vast proportions if the demands of the Foreign buyer are satisfactorily complied with.

Owing to the destruction of Railroads, Bridges, Docks and Buildings of every description in the European Countries, devastated as a result of the "Great war," enormous quantities of lumber and especially long timbers will be required for repair work and permanent constructional purposes.

The eyes of the "World" will naturally turn to the Pacific Coast in quest of information relative to Douglas Fir, California Redwood and the methods of handling these shipments, and to those requiring this knowledge, the Lumberman's and Logger's Guide will furnish the answer.

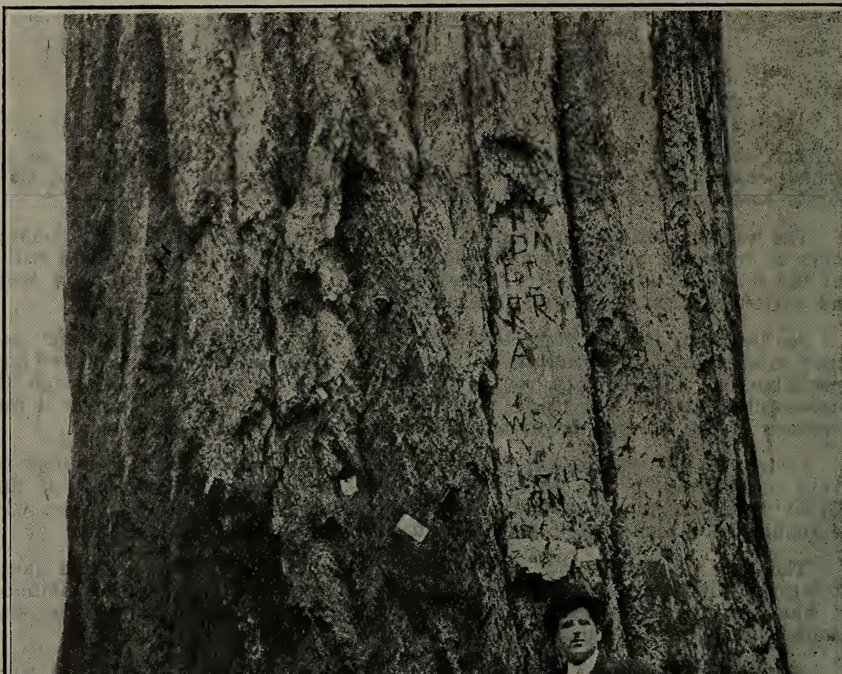
Shipowners, Captains and officers of vessels, or any one connected with the operation of cargo carriers, will appreciate the information regarding the system for computing the lumber carrying capacity of steamers also the Table of Distances which will enable the reader to ascertain the distance from the leading ports of the World to any Douglas Fir or Redwood Cargo Mill on the Pacific Coast.

In the section of this book devoted to logs will be found the log tables in general use in British Columbia, Washington, Oregon and California, the methods for computing same, also the log grading rules and a special table computed by the author showing the actual or solid contents in board feet of logs ranging from six to forty-eight inches in diameter.

To the Foreign or prospective lumber buyer who is desirous of obtaining reliable data concerning Douglas Fir or California Redwood, the information in this book can be absolutely relied upon as I have personally supervised the manufacture, inspection or shipment of upwards of fifty million board feet of Pacific Coast Lumber annually for a period of over twenty-five years.

In conclusion, I wish to express my appreciation to the officials of The United States Forest Service, the Bureau of Foreign and Domestic Commerce, the Lumber Trade Journals and my friends in the Lumber and Shipping Industries who have so courteously furnished me with much valuable material for this work.

BERNARD BRERETON,
Author and Publisher.



DOUGLAS FIR

(Tsuga Taxifolia)

DOUGLAS FIR

Pseudotsuga Taxifolia

Douglas Fir, widely known as Oregon Pine, reaches its best development for commercial purposes on the Pacific Coast, from the head of the Skeena River, in British Columbia, and southward through the States of Washington and Oregon to Central California.

The wood is comparatively light but very strong,; it is the strongest wood in the world for its weight that is obtainable in commercial sizes and quantities.

With the exception of Spruce, Douglas Fir is in greater demand for Airplane construction than any other wood, and material of excellent quality for this purpose can be furnished in unlimited amounts.

THE CORRECT NAME

Douglas Fir is named after David Douglas, botanist, who explored British Columbia (then called New Caledonia) in 1825-30. It is the most important timber tree on the North American Continent, and is known by a great variety of names, such as Oregon Pine, Oregon Fir, Washington Fir, Yellow Fir, Red Fir, Douglas Spruce, Red Spruce, Puget Sound Pine, and British Columbia Pine.

The employment of so large a number of names for one class of tree is very confusing, detrimental and often misleading, and for these reasons the United States Forest Service some years ago took a lumber census which resulted in their adopting the name Douglas Fir, as it was used more than all others combined.

MERITS AND USES

The stand of timber in Oregon and Washington alone, it is estimated, comprises 25% of the remaining stand of timber in the United States, and in British Columbia is estimated to comprise one-third of the total timber supply of Canada. It is considered the strongest softwood in the world. (See United States Forest Service Bulletin No. 108.) Douglas Fir is moderately hard but easy to work, straight grained, resilient, tough and durable.

DOUGLAS FIR

Merits and Uses - Continued

Combining these qualities of great strength, light weight, ease of working and handling more than any other commercial timber, Douglas Fir is the ideal wood for practically all building and structural purposes. Owing to the great size of the trees Douglas Fir timber can be furnished in the largest dimensions required in modern heavy construction. As complying with qualities essential in a wood acceptable for general building purposes, Douglas Fir is practically impervious to water, holds nails firmly, takes stain well in any shade or color, and combines beauty, utility and durability. It is superior wood for bridge and wharf building, heavy joists where great strength is required, studding—in fact, all ordinary framing material, ship plank, ship decking, spars, derricks, car sills, car siding, car roofing, car lining, flooring, ceiling, silo stock, sash and doors, interior finish. The lower grades are also used in large quantities for under-ground mining purposes.

The United States Forest Service Bulletin No. 88, says: "Douglas Fir may, perhaps, be considered the most important of American woods. * * * It is manufactured into every form of lumber known to the saw mill operator. For house construction Douglas Fir is manufactured into all forms of dimension stock, and is used particularly for general building and construction purposes. Its strength and comparative lightness fit it for joists, floor beams, rafters, and other timbers which must carry loads.

"The comparative hardness of the wood fits it for flooring and it meets a large demand. Douglas Fir edge-grain flooring is considered superior to that made from any other softwood.

"Clear lumber, sawed flat grain, shows pleasing figures, and the contrast between the spring and summer wood has been considered as attractive as the grain of quarter-sawn oak. It takes stain well, and by staining, the beauty of the grain may be more strongly brought out and a number of rare woods can be successfully imitated."

The durability of the wood, and the fact that it resists saturation by water cause it to be used in large quantities for wooden piping, for continuous stave and jointed conduits used in power and irrigation works, for silos and tanks. It makes first-class railway ties, whether treated with preservatives or not. Street pavement of creosoted Douglas Fir blocks properly laid is noiseless, dustless, economical in upkeep, and is durable and long wearing even under heavy traffic such as that of freight and dock yards. The unusual valuable combination of qualities possessed by Douglas Fir adapt it to such a variety of uses that a complete list of them would cover nearly all the uses to which wood can be put.

AVERAGE STRENGTH VALUES FOR STRUCTURAL TIMBERS

Taken from U. S. Forest Service Bulletin 108

GREEN

SPECIES	Cross Section Under Test, Inches.	No. of Tests.	Rings per Inch.	Moisture Content, percent.	Weight, Oven Dry lbs., per cu. ft.	Fiber Stress at Elastic Limit, lbs., per sq. in.	Modulus of Rupture, lbs. per sq. in.	Modulus of Elasticity, 1000 lbs. per sq. in.	Relative Strength Based on Modulus of Rupture, Douglas Fir, 100%.	Relative Stiffness Based on Modulus of Elasticity, Douglas Fir, 100%
Douglas Fir	8x16	134	10.9	31.8	28.9	4282	6605	1611	100.0	100.0
Western Hemlock	8x16	27	17.6	41.9	28.1	3761	5821	1489	88.1	92.4
Long-leaf Pine	12x12 10x16 8x16 6x16 6x10	13	14.6	29.2	35.4	3855	6437	1466	97.4	91.0
Short-leaf Pine	8x16 8x14 8x12	33	12.3	48.4	31.4	3376	5948	1546	90.0	96.0
Loblolly Pine	5x12 8x16	78	6.2	58.0	31.2	3266	5568	1467	84.4	91.1
Western Larch	8x16 8x12	43	23.9	50.5	28.7	3677	5562	1364	84.2	84.6
Redwood	8x16 6x12 7x9	30	19.5	90.2	23.3	4323	5327	1202	80.6	74.6

NOTE:—Care was taken in selecting Douglas Fir material to secure a large number of stringers of low grade. Douglas Fir contained more knots than its nearest competitor in strength. Even with this handicap it shows greater strength values than other species.

AVERAGE STRENGTH VALUES FOR STRUCTURAL TIMBERS

Established by the U. S. Government

SPECIES	Green Stringers Breaking Strength Lbs. sq. in.	Green Stringers Percent	Air-Seasoned Stringers Breaking Strength Lbs. sq. in.	Air-Seasoned Stringers Percent
Douglas Fir	6605	100.0	7142	100.0
Longleaf Pine	6437	97.4	5957	83.6
Shortleaf Pine	5948	90.0	7033	98.5
Western Hemlock	5821	88.1	7109	99.6
Loblolly Pine	5568	84.4	6259	87.7
Western Larch	5562	84.2	6534	91.5
Redwood	5327	80.6	4573	64.1
Tamarack	4984	75.5	5865	82.3
Norway Pine	3767	57.0	5255	73.7

Note that Douglas Fir is unequaled in strength by any other species. It is 25 percent. lighter in weight than its nearest competitor in strength.

WEIGHT OF FRESHLY SAWN DOUGLAS FIR

1000 BOARD FEET EQUALS 3333 POUNDS

To quickly ascertain the weight in pounds of "green" Douglas Fir: Add one cipher to the board feet, and divide by 3.

Example: Find the weight in pounds of 672 board feet Douglas Fir.

Process:

672 $\times$ 10 equals 6720, divided by 3 equals 2240 pounds.

$$\begin{array}{r} 3)6720 \\ \hline 2240 \text{ pounds} \end{array}$$

The above is a very close estimate for all practical purposes, and has proved correct in thousands of instances.

Lumber for export shipments can be reckoned at the rate of 1,000 board feet to 1½ tons of 2240 pounds.

Example: Find the weight in long tons of 120,000 board feet Douglas Fir.

Operation

120 $\times$ 1½ equals 180 long tons.

KILN DRIED LUMBER

Kiln dried lumber of one inch in thickness loses about one third of its weight in the process of drying. Weights of kiln dried rough and finished stock can be obtained from any Local Price List or by applying to the West Coast Lumber Manufacturers Association, Seattle, Wash., U. S. A.

METRIC WEIGHT

Weight of Douglas Fir in kilograms and metric tons is given in the Metric Section.

SPECIFIC GRAVITY

The weight of wood is sometimes expressed by a comparison of the weight of a given volume of wood with that of an equal volume of water, or by what is known as "specific gravity." If the specific gravity of a certain kind of wood is stated as .300, it means that a given volume of this wood weighs .300 times as much as an equal volume of water. Since a cubic foot of water weighs 62.5 pounds, or 1000 ounces, a cubic foot of wood of specific gravity of .300 weighs .300 $\times$ 62.5=18.75 pounds.

A cubic foot of green Douglas Fir whose specific gravity is .640, weighs .640 $\times$ 62.5 = 40 pounds per cubic foot. Hence the weight per cubic foot of any kind of wood can be quickly ascertained when the specific gravity is known.

The specific gravity of a body or substance divided by 16 will give the weight of a cubic foot of it in pounds.

Example: The specific gravity of a cubic foot of green Douglas Fir is 640; what is the weight of it?

Process:

640 divided by 16 equals 40, the weight of a cubic foot in pounds.

When the weight of a cubic foot of lumber is known, the specific gravity can be ascertained by multiplying the number of pounds by 16.

Example: Find the specific gravity of Dry Redwood weighing 26 pounds per cubic foot.

Process:

26 $\times$ 16 equals 416, the specific gravity.

LATH

The standard for California and West Coast of South America is ⅓x1½ in.—4 ft., tied in bundles of 100 pieces.

The Australian standard is as follows:
⅓x1 in.—4½ ft., tied in bundles of 90 pieces.
⅓x1¼ in.—4½ ft., tied in bundles of 90 pieces.
⅓x1½ in.—4½ ft., tied in bundles of 90 pieces

MEASUREMENTS, CONTENTS AND WEIGHTS

⅓x1½ in.—4 ft.—
1000 Pcs. contain 166⅔ ft. B. M.
6000 Pcs. equal 1000 ft. B. M.
1000 Pcs. Kiln Dried, weigh 500 lbs.
1000 Pcs. Green, weigh 700 lbs.

⅓x1 in.—4½ ft.—
1000 Pcs. contain 125 ft. B. M.
8000 Pcs. equal 1000 ft. B. M.
1000 Pcs. Kiln Dried, weigh 375 lbs.
1000 Pcs. Green, weigh 530 lbs.

⅓x1¼ in.—4½ ft.—
1000 Pcs. contain 156¼ ft. B. M.
6400 Pcs. equal 1000 ft. B. M.
1000 Pcs. Kiln Dried, weigh 470 lbs.
1000 Pcs. Green, weigh 660 lbs.

⅓x1½ in.—4½ ft.—and
⅜x1½ in.—4 ft.
1000 Pcs. contain 187½ ft. B. M.
5333 Pcs. equal 1000 ft. B. M.
1000 Pcs. Kiln Dried, weigh 560 lbs.
1000 Pcs. Green, weigh 800 lbs.

When lath are made ⅜ of an inch in thickness, the contents and weight can be computed by adding to the measurements given in the preceding table ⅛of the corresponding amount.

1000 Pcs. ⅓x1½—4 ft. lath will cover 70 yards of surface.

FREIGHT

When figuring lath of any of the foregoing sizes and length for cargo freight, the prevailing custom formerly was to reckon six pieces as being the equivalent of one foot board measure, but the correct way is to figure them at actual contents.

TO FIND THE NUMBER OF 1½-IN.X4-FT. LATH REQUIRED FOR A ROOM

Find the number of square yards in the walls and ceiling and multiply by 16, the number estimated to a square yard. The result will be the number of lath necessary to cover the room.

At 16 lath to the square yard, 1,000 lath will cover 63 yards of surface, and 11 pounds of lath nails will nail them on.

STAVES

ACCORDING TO EXPORT "H" LIST

No. 1 Staves 1x4 in. x 4 ft. Sawn full size clear. If seasoned will allow ⅛ of an inch scant in width.

No. 2 Staves 1x3 in. x 4 ft. Will allow variations in size of ⅛ of an inch in thickness and ⅛ of an inch in width. Sap and two sound hard knots not over ¾ of an inch in diameter allowed.

Weight same as pickets. See page 10.

PICKETS ROUGH

The standard size, 1x3—4 feet and 4 feet 6 inches long, are tied in bundles of 10 pieces each; they are in great demand for the Australian market, and are used for fences, and occasionally are sawn into inch lath; they are also extensively utilized as staves for mutton-tallow barrels.

GRADE ACCORDING TO EXPORT "H" LIST

Pickets 1x3 in.—4 ft.—4 ft. 6 in.—5 ft. Will allow variations in size of ⅛ of an inch in thickness and ⅛ of an inch in width. Sap, pitch pockets, and two sound hard knots not over 1 inch in diameter allowed.

MANUFACTURE

Strict attention should be paid to their manufacture, and it is essential that they be uniform in thickness. They can be made from air or kiln dried stock and many mills rip 2x3 to 15/16 of an inch to make them.

In most cases pickets are subject to rigid inspection, and it is useless to make them from anything but the best material.

DISCOLORATION

Unless there are prospects of shipping pickets within a short time after they are manufactured, they should be piled on their edge in bundles, and crossed in alternate courses with an air space between each bundle of about 4 inches. This prevents discoloration, and is the method employed by a number of mills who aim to ship their stock in a satisfactory condition.

MEASUREMENT, CONTENTS AND WEIGHT

1000 pcs. 1x3—4 feet contain 1000 feet Board Measure, and average 3500 lbs. in weight.

1000 pcs. 1x3—4½ feet contain 1125 feet Board Measure, and average 4000 lbs. in weight.

The above weight is for green stock; when seasoned lumber is used, due allowance must be made for difference in material.

CORD MEASURE

Firewood, small pulp wood, and material cut into short sticks for excelsior, etc., is usually measured by the cord. A cord is 128 cubic feet of stacked wood. The wood is usually cut into 4-foot lengths, in which case a cord is a stack 4 feet high and wide, and 8 feet long. Sometimes, however, pulp wood is cut 5 feet long, and a stack of it 4 feet high, 5 feet wide and 8 feet long is considered 1 cord. In this case the cord contains 160 cubic feet of stacked wood. Where firewood is cut in 5-foot lengths a cord is a stack 4 feet high and 6½ feet long, and contains 130 cubic feet of stacked wood. Where it is desirable to use shorter lengths for special purposes, the sticks are often cut 1½, 2, or 3 feet long. A stack of such wood, 4 feet high and 8 feet long, is considered 1 cord, but the price is always made to conform to the shortness of the measure.

A cord foot is one-eighth of a cord and equivalent to a stack of 4-foot wood 4 feet high and 1 foot wide. Farmers frequently speak of a foot of cord wood, meaning a cord foot. By the expression "surface foot" is meant the number of square feet measured on the side of a stack.

In some localities, particularly in New England, cord wood is measured by means of calipers. Instead of stacking the wood and computing the cords in the ordinary way, the average diameter of each log is determined with calipers and the number of cords obtained by cosulting a table which gives the amount of wood in logs of different diameters and lengths.

RELATION BETWEEN BOARD MEASURE, CUBIC MEASURE AND CORD MEASURE

In order to determine the number of feet in a standard cord of stacked wood (4 feet x 4 feet x 8 feet), and also to ascertain the number of solid cubic feet of wood in a cord, the class in forest mensuration of the Montana Forest School has just completed a study on this phase of the subject. A number of 16-foot softwood logs (Douglas fir, western larch and western yellow pine), averaging about 12 inches in diameter at the small end, were first scaled with Scribner Decimal "C" Rule. The logs were next cut into 4-foot lengths and the number of cubic feet in each piece accurately determined. The 4-foot lengths were next split into the usually convenient cordwood stick and stacked into a pile 4 feet high and 8 feet long. The following were the results obtained:

A standard cord (128 cubic feet) of stacked wood (Douglas fir, western larch, western yellow pine) contains:

517 board feet (Scribner Dec. "C" Scale).

963 board feet (62.7 percent) of actual wood.

80.25 cubic feet of actual wood.

37.3 percent of a stacked coard is air space.

A similar study carried out by the forestry students of the University of Wisconsin (1914), in the university oak woodlot near Madison, Wis., gave 73 cubic feet (57 percent) of actual wood per cord. This was nearly all red and black oak, and the 73 cubic feet represented the average for 23 cords of wood, used by the university as fuel.—R. R. Fenska, acting dean, University of Montana, Missoula, Mont.

It is generally agreed that the conifers pile closer in cordwood than do the hardwoods and this explains the difference in the two sets of university figures referred to in the foregoing.

METRICAL EQUIVALENT

I Stere (Cubic Meter) equals 0.2759 of a cord.

I Cord equals 3.624 Steres.

Note: 1 Stere or cubic meter equals 35.314 cubic feet.

AMOUNT OF PULP WOOD IN A CORD

A cord of wood ordinarily yields about one ton of mechanical pulp or about one-half ton of chemical pulp.

AMOUNT OF HEMLOCK BARK FOR TANNING PURPOSES IN A CORD

Although the cord is used as a standard of measure for bark, it is usually sold by weight in order to avoid variation due to loose piling.

Throughout the East 2,240 pounds are usually called a cord, although in some places 2,000 pounds are accepted.

A long cord of 2,240 pounds equals about 77 cubic feet, a short cord of 2,000 pounds equals about 66½ cubic feet.

It is highly important to keep Hemlock bark intended for tanning purposes well protected from the rain, for it leaches out easily and is soon ruined. For the same reason bark from logs which have been towed or driven is of little value.

Salt water ruins it entirely.

HOW WOOD PULP IS MADE

Wood pulp is usually made by either one or two general processes, mechanical or chemical. In the mechanical process the wood, after being cut into suitable sizes and barked, is held against revolving grindstones in a stream of water and thus reduced to pulp. In the chemical process the barked wood is reduced to chips and cooked in large digesters with chemicals which destroy the cementing material of the fibers and leave practically pure cellulose. This is then washed and screened to render it suitable for paper-making. The chemicals ordinarily used are either bi-sulphite of lime or caustic soda. A little over half of the pulp manufactured is made by the soda process. Much of the mechanical pulp, or ground wood as it is commonly called, is used in the making of newspaper. It is never used alone in making white paper, but always mixed with some sulphite fiber to give the paper strength. A cord of wood ordinarily yields about one ton of mechanical pulp or about one-half ton of chemical pulp.

BURNED OVER TIMBER FOR PULPWOOD

It is a common error to regard burned over timber as being suitable for the manufacture of wood pulp. Young green timber gives the best results for this class of work, as dead wood breaks up when put through the process of manufacture. There is also a great waste on account of the charred surface of some parts of the timber, none of which must get into the pulp. If this should occur the whole batch would be valueless.

HOW TO FIGURE LUMBER

BOARD MEASURE

Lumber is usually reckoned by Board Measures, the unit being a square foot one inch thick.

Lumber less than one inch thick is usually figured as of one inch.

The ordinary way of finding the contents of squared lumber is to multiply together the length in feet, the width and thickness in inches and divide the product by 12.

Figuring lumber by the above rule is a slow process, and the following system is adopted by experts whose business makes rapid calculation essential to their success.

Multiply together the thickness and width in inches, divide the product by 12 and multiply result by the length; the answer is Board Measure contents.

EXAMPLES

A few examples will show the system for finding the contents of standard sizes in a few seconds, and many of them without a moment's hesitation.

Example: Find the Board Measure contents of the following sizes:

Pcs.	Size.	Length.	B.M.
1	2x 8 inches	30 feet	40
1	4x10 inches	18 feet	60
1	10x10 inches	36 feet	300
1	20x20 inches	60 feet	2000

Operation

2x8 equals 16 divided by 12 equals $\frac{16}{12}$ or $1\frac{1}{3}$. When this is multiplied by the length the answer is 40 feet; in other words, add one-third to the length and you have the Board Measure contents.

Operation

4x10 equals 40 divided by 12 equals $3\frac{1}{3}$ or $\frac{10}{3}$. In this instance a cipher is added to the length and when this is divided by three the result is 60 feet Board Measure contents.

10x10 equals 100; this divided by 12 equals $8\frac{1}{3}$, or $\frac{100}{12}$. It is easier to multiply by 100 and divide by 12 than to multiply by $8\frac{1}{3}$, therefore add two ciphers to the length and divide by 12; the result is 300 feet Board Measure contents.

20x20 equals 400, divided by 12 equals $33\frac{1}{3}$, or 100/3. All that is necessary is to add two ciphers to the length and divide by 3; the result is 2000 feet, Board Measure contents.

After a short reflection on the above method, it will be apparent to everyone that when this system is used I have made good my statement that the contents of any ordinary stick of lumber can be figured inside of a few seconds.

The following standard sizes and multiples for same will serve as a basis for practice, and when memorized will benefit those who wish to become rapid in figuring lumber, and at the same time may prove a stepping stone to a better position and successful career.

STANDARD SIZES AND MULTIPLES

1 x 3	Divide lineal feet by 4.
1 x 4	Divide lineal feet by 3.
1 x 6	Divide lineal feet by 2.
1 x 8	Multiply lineal feet by 2 and divide by 3.
1 x10	Multiply lineal feet by 10 and divide by 12.
1 x12	Lineal feet and Board Measure the same.
2 x 3	Divide lineal feet by 2.
2 x 4	Multiply lineal feet by 2 and divide by 3.
2 x 8	Add to lineal feet ⅓ of amount.
2 x10	Multiply lineal feet by 10 and divide by 6.
2 x12	Multiply lineal feet by 2.
3 x 3	Multiply lineal feet by 3 and divide by 4.
3 x 4	Lineal feet and Board Measure the same.
3 x 6	Add to lineal feet ½ the amount.
3 x 8	Multiply lineal feet by 2.
3 x10	Multiply lineal feet by 10 and divide by 4.
3 x12	Multiply lineal feet by 3.
4 x 4	Add to lineal feet ⅓ of amount.
4 x 6	Multiply lineal feet by 2.
4 x 8	Multiply lineal feet by 3 and subtract ⅓ lineal feet from amount.
4 x10	Multiply lineal feet by 10 and divide by 3.
4 x12	Multiply lineal feet by 4.
8 x 8	Multiply lineal feet by 5⅓.
10x10	Multiply lineal feet by 100 and divide by 12.
12x12	Multiply lineal feet by 12.
14x14	Multiply lineal feet by 16⅓.
16x16	Multiply lineal feet by 21⅓.
18x18	Multiply lineal feet by 27.
20x20	Multiply lineal feet by 100 and divide by 3.
22x22	Multiply lineal feet by 40⅓.
24x24	Multiply lineal feet by 48.

ANOTHER METHOD

A handy method for computing Board Measure contents, preferred by a number of lumbermen, is as follows:

For all 12 ft. lengths, multiply width by thickness.
For all 14 ft. lengths, multiply width by thickness, and add ⅙.
For all 16 ft. lengths, multiply width by thickness, and add ⅓.
For all 18 ft. lengths, multiply width by thickness, and add ½.
For all 20 ft. lengths, multiply width by thickness, and add ⅔.
For all 22 ft. lengths, multiply width by thickness, and add ⅚.
For all 24 ft. lengths, multiply width by thickness, and double.

Some objection may be taken to the use of ⅔ and ⅚, but often by transposition you can substitute ⅙, ⅓, or ½, as in the following:

Examples:

10 pcs. 1x18—22 changed to 10 pcs. 1x22—18.

16 pcs. 1x22—20 changed to 20 pcs. 1x22—16.

In the first example, instead of multiplying 10x18 and adding ⅚ to the result, multiply 10x22 and add one-half to the result, which will give 330 ft. Board Measure. In the second item, instead of multiplying 16x22 and adding ⅔, multiply 20x22 and add ⅓, which gives 586⅔ ft. Board Measure.

The above system is very handy, when figuring lumber from 12 to 24 feet in length, and also where odd widths and thicknesses frequently occur.

MULTIPLICATION

In computing contents of lumber it is often necessary to multiply by the figures from 13 to 19. A simple process is to multiply by the unit of the multiplier, set down the product under, and one place to the right of, and then add to the multiplicand.

Example: Multiply 238 by 15.

```
238
 1190
----
3570 Answer
```

To multiply any number by 101 to 109.

Example: Multiply 24356 by 103.

```
24356
  73068
-------
2508668 Answer
```

Multiply by the unit of the multiplier, placing the product two figures to the right as in above example.

To multiply by 21-31-41-51-61-71-81-91.

Set the product by the tens under the multiplicand in proper position and add, thus:

Example: Multiply 76432 by 61.

Operation:

```
 76432x61
458592
-------
4662352
```

If ciphers occur between the two digits of the multiplier, the same method can be used by placing the figures in the correct position, thus:

Example: Multiply 76432 by 6001.

Operation:

```
      76432x6001
458592
---------
458668432
```

FRACTIONAL SIZES

To find the Board Measure contents of lumber 1¼ and 1½ inches in thickness, proceed as if the lumber were of one inch and to the amount obtained add one-quarter or one-half, as the case may be.

To bring the lineal feet of fractional lumber to board measure when your time is limited, and you are not familiar with the correct multiple, multiply the lineal feet by the thickness, width and length and divide result by twelve.

ADDITION OF FRACTIONS

Find the sum of $\frac{3}{8}$ and $\frac{5}{13}$

$$\overset{39}{\frac{3}{8}} + \overset{40}{\frac{5}{13}} = \frac{79}{104} \text{ Answer}$$

Explanation: Multiply the denominator (8) of the first fraction by the numerator (5) of the second fraction, which gives 40. Next multiply the numerator (3) of the first fraction by the denominator (13) of the second fraction, which gives 39. Now unite these products (40+39=79), which gives the numerator of the answer. The denominator of the answer is the product of the denominators (8×13=104).

MULTIPLICATION OF FRACTIONS

When both the whole numbers are the same, and the sum of the fractions is a unit.

Examples:

Multiply $4\frac{1}{2}$x$4\frac{1}{2}$ Answer $20\frac{1}{4}$
Multiply $7\frac{3}{8}$x$7\frac{5}{8}$ Answer $56\frac{15}{64}$
Multiply $9\frac{1}{3}$x$9\frac{2}{3}$ Answer $90\frac{2}{9}$

Operation:

$4\times4+4=20+\frac{1}{2}\times\frac{1}{2}=20\frac{1}{4}$
$7\times7+7=56+\frac{3}{8}\times\frac{5}{8}=56\ \frac{15}{64}$
$9\times9+9=90+\frac{1}{3}\times\frac{2}{3}=90\ \frac{2}{9}$

When the whole numbers are alike and the fractions are one-half, such as $1\frac{1}{2}$x$1\frac{1}{2}$, $2\frac{1}{2}$x$2\frac{1}{2}$, $12\frac{1}{2}$x$12\frac{1}{2}$, add one to one of the whole numbers, then multiply the whole numbers together and to the result add the multiplication of the halves, which always equals one-quarter.

The following examples are self-explanatory:

As Common Fractions:

$1\frac{1}{2}\times$	$1\frac{1}{2}$	equals	$1\times$	2	plus	$\frac{1}{4}$	or	$2\frac{1}{4}$	Answer
$2\frac{1}{2}\times$	$2\frac{1}{2}$	equals	$2\times$	3	plus	$\frac{1}{4}$	or	$6\frac{1}{4}$	Answer.
$3\frac{1}{2}\times$	$3\frac{1}{2}$	equals	$3\times$	4	plus	$\frac{1}{4}$	or	$12\frac{1}{4}$	Answer.
$12\frac{1}{2}\times$	$12\frac{1}{2}$	equals	$12\times$	13	plus	$\frac{1}{4}$	or	$156\frac{1}{4}$	Answer.
$109\frac{1}{2}\times$	$109\frac{1}{2}$	equals	$109\times$	110	plus	$\frac{1}{4}$	or	$11990\frac{1}{4}$	Answer.

AS DECIMAL FRACTIONS

1.5$\times$	1.5	equals	1$\times$	2	plus	25/100	or	2.25
2.5$\times$	2.5	equals	2$\times$	3	plus	25/100	or	6.25
3.5$\times$	3.5	equals	3$\times$	4	plus	25/100	or	12.25
12.5$\times$	12.5	equals	12$\times$	13	plus	25/100	or	156.25
109.5$\times$	109.5	equals	109$\times$	110	plus	25/100	or	11990.25

MULTIPLICATION OF MIXED NUMBERS

Multiply $46\frac{2}{3}$ by $21\frac{7}{8}$.

Operation:

```
322) 46⅔
 42) 21⅞
     ------
     966.14
      40.6
      14.0
     ------
     1020 20/24
```

Explanation: Find the product of the whole numbers (966) and to the right put down the product of the numerators of the fractions ($2\times7=14$). Now multiply the numerator (7) of the lower fraction by the upper whole number (46), which gives 322. Write this on the left of the upper number. Now divide the product thus obtained by the denominator (8) of the lower fraction, which gives 40 and a remainder of 2. Write the 40 in the whole number column and the remainder (2) we multiply by the upper denominator (3), which gives a product of 6 and is written under 14 in the fraction column.

Now multiply the lower whole number (21) by the numerator (2) of the upper fraction, which gives 42. Write it on the left. Now divide 42 by the denominator (3) of the upper fraction, which gives 14 and no remainder. Write a cipher in the fraction column. Now add the partial product and the product is complete. In cases where the partial products of the fractions amount to more than 1, carry the excess to the whole numbers.

DIVISION OF MIXED NUMBERS

Divide $46\frac{5}{8}$ by 7.

Operation:

$$7\overline{)46\frac{5}{8}}$$

$$6\frac{37}{56}$$

Explanation: In cases where the divisor is a whole number, the foregoing example does away with the usual method of reducing dividend and divisor to the same denomination.

Proceed as follows: 7 is contained 6 times in 46, with a remainder of 4. Write down 6 to produce the fraction of the quotient we multiply the remainder (4) by the denominator (8), which gives 32; to this is added the numerator (5) and we have the 37, the numerator of the quotient.

The product of the divisor by the denominator is the denominator (56) of the answer.

SHORT RULES

3-inch Plank: One-half the width multiplied by half the length, gives the Board Measure contents.

12-foot Lengths: The Board Measure contents of any piece of lumber 12 feet long is equal to the thickness and width multiplied together.

Lumber 6 inches in Thickness: Half the width multiplied by the length gives the Board Measure contents.

To find Board Measure contents of 4x8in. multiply lineal feet by 2 and add one-third to the product.

Example: How many feet board measure are there in a piece of 4x8-in. 30 feet long?

Operation:

	30
Multiplied by	2
	60
⅓ of 60=	20
	80 ft. B. M. Answer.

To find board measure contents of 8x8in. divide lineal feet by 2, add one cipher to the result and to this amount add one-third of the lineal feet. This system requires no mental effort in even lengths up to 26 feet long.

Example: Find board measure contents of 1 piece 8x8in.—18 and 26 ft. long respectively.

Operation:

18 divided by 2 equals 9.
18 divided by 3 equals 6.

Place the 6 to the right of 9 and you have the answer, 96 ft. B. M.

26 divided by 2 equals 13.
26 divided by 3 equals 8⅔.

Place the 8⅔ to the right of 13 and you have the answer, 138⅔ ft. B. M.

To Convert Board Measure to Lineal Feet, simply reverse the multiple used to bring lineal feet to Board Measure; in other words, multiply Board feet by 12 and divide by thickness and width.

Example: How many lineal feet are there in 1000 feet Board Measure of 2x8?

Process:

```
       1000
         12
    -------
    2) 12000
    -------
    8)  6000
    -------
        750 lneal feet.. Answer.
```

Car orders frequently call for a specified amount of sizes containing special lengths. Before proceeding to load, it is necessary to find the number of pieces required.

Find the number of pieces in the following order:

1000 ft. B. M. 2x4-14.
1000 ft. B. M. 2x4-16.
1000 ft. B. M. 2x4-20.

Bring the Board Measure to lineal feet as shown in previous example, then divide the length into lineal feet. The result will be the number of pieces.

Process:

```
       1000
         12
    -------
    2) 12000
    -------
    4)  6000
    -------
       1500 lineal feet.
```

The lineal feet given is now divided by the respective lengths and the following answer is obtained:

```
107 Pcs. 2x4—14 containing  998 ft. 8 in. B. M.
 94 Pcs. 2x4—16 containing 1002 ft. 8 in. B. M.
 75 Pcs. 2x4—20 containing 1000 ft.       B. M.
---                        ----
276                        3001 ft. 4 in. B. M.
```

FIGURING SQUARE TIMBERS

This method of computing the Board Measure contents of square or rectangular timbers that exceed 12 inches one or both ways, is known to but very few, if any, lumbermen. It is a rapid way of figuring the majority of sizes, and on account of its simplicity the system is easily committed to memory.

FIGURING RECTANGULAR TIMBERS

Rule: Multiply length by width, and to the result add one-twelfth of the thickness for each inch that exceeds twelve.

Example: Find the Board Measure contents of a timber 13-in x 17-in.—48 feet long.

Operation:

```
                               48
                              336
                              ---
 48 multiplied by 17 equals   816
816 divided    by 12 equals    68
                              ---
                              844 Ans. in B. M. Contents.
```

Explanation: Multiply the length (48 ft.) by the width (17in.), which equals 816. Now as the thickness (13) exceeds 12 inches by one inch, consider this as one-twelfth, which is divided into 816 and equals 68. This amount is added to the 816 and the result is 884 ft. Board Measure contents.

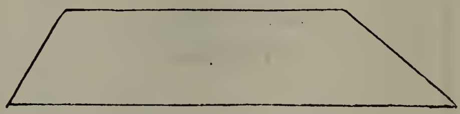
The following multiples will be of assistance to those who wish to practice this system of finding Board Measure contents of timbers by the preceding rule.

12x13 Multiply length by 13
13x14 Multiply length by 14 and add 1/12 of result
14x14 Multiply length by 14 and add 1/6 of result
14x15 Multiply length by 15 and add 1/6 of result
15x15 Multiply length by 15 and add 1/4 of result
15x16 Multiply length by 16 and add 1/4 of result
16x16 Multiply length by 16 and add 1/3 of result
16x17 Multiply length by 17 and add 1/3 of result
16x18 Multiply length by 18 and add 1/3 of result
18x18 Multiply length by 18 and add 1/2 of result
24x24 Multiply length by 24 and 2
26x26 Multiply length by 26 and 2 1/6
28x28 Multiply length by 28 and 2 1/3
30x30 Multiply length by 30 and 2 1/2
36x36 Multiply length by 36 and 3

TAPERING LUMBER

How to Figure Trapezoids, or Boards With Only Two Parallel Sides

Find the Board Measure contents of a board one inch thick, whose parallel sides are 16 feet and 20 feet in length and 8 inches wide.

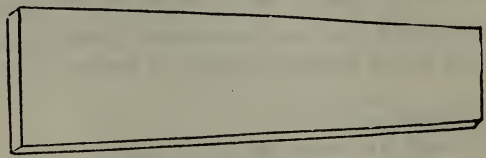


Add together the two parrellel sides, and divide their sum by 2, multiply the result by the inches in width and divide by 12. The answer is 12 feet Board Measure contents.

Operation:

```
     16
     20
   ----
 2)  36
   ----
     18
      8
 ------
 12)144
 ------
     12 ft. Board Measure.
```

Find the Board Measure contents of a board one inch thick, 24 feet long whose parallel ends are 10 inches and 18 inches respectively.



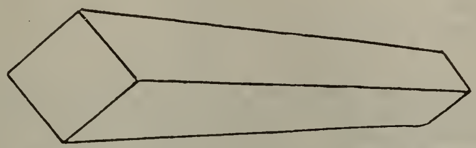
Operation:

```
     10
     18
   ----
 2)  28
   ----
     14
     24
 ------
 12)336
 ------
     28 ft. Board Measure.
```

HOW TO FIGURE THE FRUSTUM OF A PYRAMID, OR TAPERING TIMBER

As it frequently occurs there is a difference of opinion as to the correct way of ascertaining the Board Measure contents of tapering timber, the following method is both simple and correct, and will enable anyone to figure the exact contents without diving into square root.

Find the contents of a timber 40 feet high, 12x12 inches at the bottom and 6x6 inches at the top.



Square both ends separately, then multiply the top by the bottom side, add the sum together, and multiply this by the height and in all cases divide by 36.

Operation:

```
      12x12     144 bottom
       6x 6      36 top
       6x12      72 top and bottom
              ------
                252
                 40 ft. high
              ------
         36) 10080 ( 280 ft. B. M.—Ans.
              72
             ----
             288
             288
             ----
               0
```

The common error that would be made in figuring a timber of this dimension would be to call it 9x9 the supposed size at the middle; the contents in that case would be 270 feet, or a difference of 10 feet. This is an important item that should be taken into consideration when figuring on contracts or freight.

I will now prove the method I use is correct by figuring a square timber on the same principal as a tapering stick.

Find the Board Measure contents of a timber 12 inches square and 40 feet long.

Operation:

```
      12x12     144 bottom
      12x12     144 top
      12x12     144 top and bottom
              ------
                432
                 40 ft. long.
              ------
         36) 17280 (480 ft. B. M. contents.
             144
             ----
             288
             288
             ----
               0
```

CONTENTS BY PROGRESSIVE ADDITION

This rule is of great advantage when there is a range of odd and even lengths.

Example 1: Find the number of lineal feet in the following:

Ft. Long.	Pieces.	Lin. Ft.
10	0	480
11	8	48
12	6	40
13	4	34
14	7	30
15	23	23
	48	655

Explanation: First put down the pieces of the longest length (23 Pcs.) to this, add the pieces of the next longest length (7 Pcs.), which makes 30, put this down over the 23; now add to this the next number of pieces (4), which makes 34; add the next number (6), which makes 40; to this add the 8, which makes 48. The last item, in this case 48, if correct, will correspond with the total number of pieces.

This number (48) is multiplied by the shortest length, minus one, which in this case is ten. Now 48×10 equals 480; add this amount to the figures already obtained and the grand total is the number of lineal feet (655), not board feet.

When there are missing lengths repeat the number of pieces as shown by the following example:

Example 2:

Ft. Long.	Pieces.	Lin. Ft.
12	0	924
13	15	77
14	0	62
15	19	62
16	0	43
17	43	43
	77	1211

Explanation: In the foregoing example there are no pieces 14 or 16 feet long, so the amounts are repeated when there is a blank length. As in Example No. 1, the total pieces are multiplied by the shortest length, minus one. In this instance the 77 pieces are multiplied by 12, which gives 924, and the total addition shows 1211, the lineal feet.

FOR EVEN LENGTHS ONLY

Find the number of lineal feet in the following:

Ft. Long.	Pieces.	Lin. Ft.
12	46	287
14	54	241
16	62	187
18	58	125
20	67	67
	287	907
		907
		2870
		4684

Explanation: This system is the same as the preceding examples, with the exception that the addition (907) is repeated or doubled, and to this is added the number of pieces (287) multiplied by the next shortest even length (10). These items are now added together and the result shows the lineal feet (4684).

CARGO SPECIFICATIONS

As there does not seem to be any fixed rule for making up specifications in a uniform manner, reference to this subject will not be out of place. Some mills adopt the system of making all Domestic and Foreign Export Specifications out in feet Board Measure for each size and length, while others make out their specifications in lineal feet for each length and then add up their total and bring same to Board Measure.

The latter system of making out the extensions in lineal feet should be universally adopted, as everyone who is familiar with this class of work knows that a specification with the extensions in lineal feet, and showing the totals in Board Measure, can be finished in a quarter the time of a specification that shows the feet Board Measure for each length.

Steam schooners often arrive at San Francisco before the cargo manifest reaches consignee; this inconvenience and delay could often be avoided by the time gained in making up specifications with the extensions in lineal feet instead of Board Measure.

Foreign buyers, especially in the British trade, use the lineal measure more extensively than any other, and when they receive specifications in feet Board Measure they are put to the unnecessary inconvenience of converting them to lineal feet to correspond with their tables and price lists.

SHORT METHOD OF FIGURING SPECIFICATIONS

A very easy and short method of obtaining the Board Measure contents of each size and length, when required, is to halve the length and double the thickness. Simple as this rule seems, it is unknown to many experts.

Example: Find the Board Measure contents of each length in the following size:

Pieces.	Size.	Length.	B. M. Feet
53	2 x 10	12	1060
42	2 x 10	14	980
36	2 x 10	16	960
48	2 x 10	10	1440
36	2 x 10	20	1200
30	2 x 10	22	1100
12	2 x 10	24	480
257			7220

In the above example, instead of saying twelve times fifty-three, halve the length and say six times fifty-three is three hundred and eighteen (318); now by doubling the thickness, we have the equal of 4x10 stead of 2x10; therefore, by adding a cipher to the 318 and dividing by 3, we have the Board Measure contents of the first length. The same rule applies to the remainder of lengths.

When it is only necessary to find the total feet Board Measure in a size containing a range of lengths, halve the lengths or pieces, and multiply the total result by the multiple of double the thickness of the size.

Example: Find the total feet Board Measure contained in the following:

Pieces.	Size.	Length	Contents.
224	3 x 6	16	1792
112	3 x 6	18	1008
568	3 x 6	20	5680
45	3 x 6	22	495
120	3 x 6	24	1440
1069			10415
			3
		Feet B. M.	31245

HOW TO DECREASE OR INCREASE ORDERS

The method of decreasing or increasing orders will now be explained.

Reduce the following order by 44,000 feet Board Measure:

240,000 feet 12x12—40 to 60
280,000 feet 14x14—40 to 60
420,000 feet 16x16—40 to 60
160,000 feet 18x18—40 to 60

1,100,000

The first step necessary is to find the required percentage to reduce order in proportion. This is done by adding two ciphers to the amount that the order is to be reduced by and dividing the result by the amount of order. In this case it is 4 per cent. Each item must now be reduced separately by the percentage obtained, as follows:

Amt. of Decrease.		Original Order.		Reduced Order.
9,600 ft. or 4%	from	240,000 ft.	leaves	230,400
11,200 ft. or 4%	from	280,000 ft.	leaves	268,800
16,800 ft. or 4%	from	420,000 ft.	leaves	403,200
6,400 ft. or 4%	from	160,000 ft.	leaves	153,600
44,000		1,100,000		1,056,000

If the above order of 1,100,000 feet had to be increased by 44,000 feet, 4% would be added to each item, and the total would show the amount of order when increased.

FIGURING PERCENTAGES

Cargo orders for California usually call for stipulated percentages of Nos. 1 and 2 in the merchantable grades and clear and select in the uppers.

During progress of loading, it is essential to keep posted on the proportion of the percentage so as to avoid over-running or falling short on a grade.

Presume an order calls for 800,000 feet Nos. 1 and 2 Mcht., 25% No.2 allowed, and in figuing up to see how your percentage is, you find your order stands thus:

306,600 ft. No. 1
113,400 ft. No. 2

420,000 ft. Total on board.

The following is the way to find your percentage:

Cut off the two right hand figures in your total (420,000) and divide the remaining amount (4200) into the Nos. 1 and 2 respectively. If your answer is correct your combined percentages will add to 100.

Operation:

No. 1 Mcht.	No. 2 Mcht.
4200)306600(73%	4200)113400(27%
29400	8400
12600	29400
12600	29400

Amount of Percentage

306,600 No. 1 or 73% of 420,000
113,400 No. 2 or 27% of 420,000

420,000 Total 100%

As your No. 2 in this instance exceeds the 25 % allowed, notify the proper authorities of the fact, so that arrangements can be made to bring grade up to the required percentage.

STANDARDS

The "St. Petersburg Standard" is used in Great Britain, almost to the entire exclusion of all other standards.

The wholesale trade as a rule sells boards, battens, deals, planks, etc., by the Standard.

The Standard (St. Petersburg) deal contains 1 piece 3x11—6 feet and 120 pieces of this dimension make one Standard.

COMPOSITION OF STANDARDS

	Pcs.	Size. Inches.	Length. Feet.	B. M Contents.	Cu. Ft.
St. Petersburg	120	1½x11	12	1980	165
Irish or London	120	3 x 9	12	3240	270
Christiana	120	1¼x 9	11	1237½	103⅛
Drammen	120	2½x 6½	9	1462½	121⅞
Quebec	100	2½x11	12	2750	229⅙

The Drontheim Standard varies for different kinds of lumber. It contains:
2376 feet B. M. of Sawn Deals.
2160 feet B. M. of Square Timber.
1728 feet B. M. of Round Timber.

The Wyburg Standard contains:
2160 feet B. M. of Sawn Deals.
1963⅔ feet B. M. of Square Timber.
1560 feet B. M. of Round Timber.
100 St. Petersburg Stadard Deals equal 60 Quebec Deals.

The Riga "Last" contains 960 feet B. M. of Sawn Deals or Square Timber.

A Cubic Fathom of Lathwood is 6 ft. x 6 ft. and contains 216 cubic feet or 2592 feet B. M.

A Gross Hundred (120) pieces) makes a Standard Hundred.

FIGURING OF STANDARDS

Bring the following specification to Standard Measurement:
24 Pieces ¾x5½ 24
20 Pieces 1 x6 16
20 Pieces 1 x12 20
40 Pieces 2 x10 24
10 Pieces 2 x12 22

Reduce each item as follows by multiplying the number of Pieces and all their dimensions together.

24x¾x5½x24	20x1x6—16	20x1x12—20
¾	1	1
18	20	20
5½	6	12
99	120	240
24	16	20
2376	1920	4800

When the products are obtained, then add together the totad number of inches as shown in the specification below, which totals:
24 Pieces ¾x5½ 24— 2376 inches.
20 Pieces 1x6 16— 1920 inches.
20 Pieces 1x12 20— 4800 inches.
40 Pieces 2x10 24—19200 inches.
10 Pieces 2x12 22— 5280 inches.

33576 inches.

Always divide the total (in this instance 33576) by the following figures, which are standing divisors and never vary; thus:

11)33576

18)3052

30)169 10/18

4)5.19 10/18 Std. Quarters. Deals. Parts.

1.1.19 10/18 equals, 1 1 19 10/18

FREIGHT MEASUREMENT OF TIMBER AS USED IN ENGLAND

A St. Petersburg Standard Hundred contains 120 pieces of 12 feet × 1½ inches × 11 inches=165 cubic feet, or 1,980 superficial feet of 1 inch.

Deals, battens, scantings, rough boards, and sawn pitch pine timber, pay freight per St. Petersburg Standard Hundred.

Planed boards pay freight on actual measure when dressed, not by the specification of nominal sizes from which they are manufactured.

Squared timber pays freight per load of 50 cubic feet, Queen's calliper measure delivered.

Mahogany and cedar from Cuba pay freight per load of 50 cubic feet, Queen's calliper measure, the captain paying the measuring charge.

Most furniture woods pay freight per ton weight delivered.

1 shipping ton equals 42 cubic feet of Timbers.

100	Superficial feet of planking	equal 1 square
120	Deals	equal 1 hundred
50	Cubic feet of squared timbers	equal 1 load
40	Cubic feet of unhewn timbers	equal 1 load
600	Superficial feet of inch boards	equal 1 load
216	Cubic feet of lathwood	equal 1 fathom
108	Cubic feet of wood	equal 1 stack
128	Cubic feet of wood	equal 1 cord

Timber at 50 cube feet to one ton.

Pitchpine, Spruce, Whitewood, Redwood, Elm, Walnut, Maple, Pine, Baltic, Dantzig, Riga, and Memel Fir Timber are computed as weighing 50 cubic feet to the ton.

Timber at 40 cube feet to one ton

Birch, Oak, Ash, Elm, Mahogany, Teak, Beech, Green Heart, Hickory, and Round Timber generally are computed as weighing 40 cubic feet to the ton.

TO FIGURE CAPACITY OF FREIGHT CARS

LUMBER

To find the amount of Rough Green Lumber any car will carry, cut off a cipher from the marked capacity in pounds, add 10 per cent. and multiply by 3; the result will be the limit of feet Board Measure the car is allowed to carry.

Example: What is the limit in feet Board Measure allowed a car of 80,000 pounds capacity?

8000 pounds.
800 10 per cent.

8800x3 equals 26,400 ft. Board Measure.—Answer.

SHINGLES

To find approximate number of 16-inch Shingles that can be loaded in a box car.

Ascertain cubical capacity of the car, and to the number of cubic feet add two ciphers; the result will be the number of Shingles.

When loading Shingles or Lumber in furniture cars, precautions should be taken against exceeding the weight limit.

OCTAGON SPARS

As the custom is now becoming general to order Octagon Spars, both Sawn and Hewn, the information on this subject will be appreciated by those who make a specialty of this line.

An Octagon can be made out of a Square timber by the following rule:

From diagonal deduct one side of timber, and that will give one side of the Octagon.

To find the length of the side of the triangle to be taken off the corner of the timber at right angles to the diagonal, deduct half the diagonal from one side of the timber.

One side of a square timber dividid by .707 gives the diagonal.

Example:

Find the length of one side of an Octagon that can be made out of a timber 35 inches square.

Diagonal of 35x35=49.50 inches.
One side of 35x35=35.00 inches.

One side of Octagon=14.50 inches.

Example:

What is the length of the side of a triangle to be taken off the corner of a timber 35 inches square to make an Octagon?

Process:

2)49.50 Dagonal

24.75 Half the Diagonal.
35.00 Inches one side of timber.
24.75 Inches, half the diagonal.

10.25 Inches length of one side of triangle.

To find one side of an Octagon inscribed in a circle, multiply diameter by .38265.

To find area of an Octagon multiply square of side by 4.82843.

When one side of a square is given, to find one side of an Octagon, that can be made out of it—multiply one side of square by .41421.

When one side of an Octagon is given, to find the diameter of the circumscribed circle, multiply one side of the Octagon by 2.613.

TO COMPUTE THE BOARD FEET CONTENTS OF AN OCTAGON

To compute the board feet contents of an octagon multiply the square of one side of the Octagon by 4.82843; then multiply the result by the length and divide by 12.

Example:

Find the board feet contents of an Octagon, one side of which is 4 inches and the length 60 feet.

Process:

	4.82843	decimal term
Multiplied by	16	the square of 4
	77.25488	
Multiplied by	60	the length
Divided by 12)	4635.29280	
	386.2744	Board Feet Contents.

ANOTHER METHOD

To compute the board feet contents of an Octagon manufactured out of a square timber.

First find the contents of the square timber in the usual way, then square one side of the Octagon; multiply it by the length and divide by 12; subtract this amount from the contents of the square timber and the result will give the board feet contents of the Octagon.

Example:

Find the board feet contents of an Octagon the side of which is 14½ inches, made of a timber 35 inches square and 60 feet long.

Process:

35" x35" —60 ft. equals 6125 Board Feet.
14½x14½—60 ft. equals 1051¼ Board Feet.

Contents of the Octagon 5073¾ Board Feet.

Note:

The exact side of a square from which an Octagon of 14½ inches could be made, would be 35.0065 inches. In the foregoing example the figures past the decimal point, namely .0064 are discarded as being unnecessary for practical purposes.

EXPLANATION OF OCTAGON TABLE

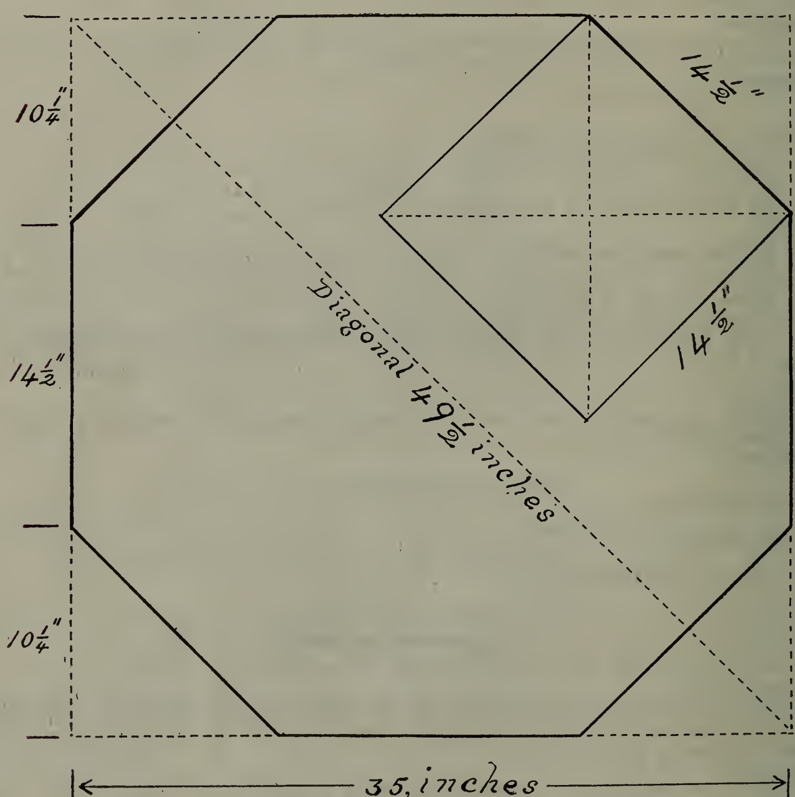
See Table on page 29.

First Column shows the size of the timber to be made into an Octagon.

Second Column shows the diagonal or the length of a line joining the opposite angles of the timber.

Third Column shows the length of one side of the Octagon that can be made from the timber in First Column.

Fourth Column shows the length of one side of the triangle to be cut off each corner of the timber at right angles to the diagonal to make the Octagon.



The above diagram illustrates the system used in determining the contents of an Octagon. Note that one side of the square (35) deducted from the diagonal (49½) gives one side of the Octagon, and that the side of the small inner square equals one side of the Octagon. You will also observe that the area of the small square or combinel areas of the four sections of the small square is the equivalent to the total area of the four corners taken off the large square to make the Octagon.

USEFUL TABLE FOR MAKING OCTAGONS OUT OF SQUARE TIMBER

Square Timber First Column	Diagonal Second Column	One Side of Octagon Third Column	One Side of Corner Fourth Column	Square Timber First Column	Diagonal Second Column	One Side of Octagon Third Column	One Side of Corner Fourth Column
6x 6	8.48	2.48	1.76	22x22	31.12	9.12	6.44
7x 7	9.90	2.90	2.05	23x23	32.53	9.53	6.73
8x 8	11.31	3.31	2.35	24x24	33.95	9.95	7.02
9x 9	12.73	3.73	2.63	25x25	35.36	10.36	7.32
10x10	14.14	4.14	2.93	26x26	36.78	10.78	7.61
11x11	15.56	4.56	3.22	27x27	38.19	11.19	7.90
12x12	16.97	4.97	3.51	28x28	39.60	11.60	8.20
13x13	18.39	5.39	3.81	29x29	41.02	12.02	8.49
14x14	19.80	5.80	4.10	30x30	42.43	12.43	8.78
15x15	21.22	6.22	4.39	31x31	43.85	12.85	9.07
16x16	22.63	6.63	4.69	32x32	45.26	13.26	9.37
17x17	24.05	7.05	4.97	33x33	46.68	13.36	9.66
18x18	25.46	7.46	5.27	34x34	48.09	14.09	9.95
19x19	26.87	7.87	5.56	35x35	49.50	14.50	10.25
20x20	28.29	8.29	5.85	36x36	50.90	14.92	10.54
21x21	29.70	8.70	6.15				

TO COMPUTE THE AREA OF A REGULAR POLYGON

When length of a side only is given.

Rule:

Multiply square of the side by multiplier opposite to term of polygon in the following table:

No. of Sides	Polygon	Multiplier
3	Trigon	.43301
4	Tetragon	1.
5	Pentagon	1.72048
6	Hexagon	2.59808
7	Heptagon	3.63391
8	Octagon	4.82843
9	Nonagon	6.18182
10	Decagon	7.69421
11	Undecagon	9.36564
12	Dodecagon	11.19615

TO COMPUTE THE BOARD FEET CONTENTS OF A REGULAR POLYGON

Rule:

Multiply square of the side by multiplier opposite to the term of polygon in the foregoing table; then multiply the result by the length and divide by 12.

Example:

Find the board measure contents of a Nonagon (9 equal sides) one side of which is 6 inches and the length is 30 feet.

Process:

	6.18182	Decimal Term
Multiplied by	36	the square of 6 inches
	37.09092	
	185.4546	
	222.54552	
Multiplied by	30	the length
Divided by 12)	6676.36560	
	556.36380	Board Feet Contents.

TO COMPUTE CONTENTS OF A TAPERING OCTAGON OR FRUSTUM OF A PYRAMID

Rule:

To the sums of the areas of the two ends of the tapering octagon or frustum add the square root of their product. Multiply the sum by the height and take one-third of the product.

Example:

Find the cubic contents of a frustum of a pyramid whose height is 15 feet. The area of one end is 18 square feet and the other 98 square feet.

Operation:

$18+98=116$ (area of the two ends).

$98\times18=1764$ square root of $1764=42$.

$116+42=158$ 15 (height)x158=2370, which divided by 3 gives 790 cubic feet.

Remark:

This rule also applies to frustums of cones.

—Contents of 1-inch Boards of Different Lengths and Widths Given in Board Feet and Twelfths.

Length.	WIDTH OF BOARD (INCHES).																					
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	CONTENTS (BOARD FEET).																					
Feet.																						
4	1	1^{4}	1^{8}	2	2^{4}	2^{8}	3	3^{4}	3^{8}	4	4^{4}	4^{8}	5	5^{4}	5^{8}	6	6^{4}	6^{8}	7	7^{4}	7^{8}	8
5	1^{3}	1^{8}	2^{1}	2^{6}	2^{11}	3^{4}	3^{9}	4^{2}	4^{7}	5	5^{5}	5^{10}	6^{3}	6^{8}	7^{1}	7^{6}	7^{11}	8^{4}	8^{9}	9^{2}	9^{7}	10
6	1^{6}	2	2^{6}	3	3^{6}	4	4^{6}	5	5^{6}	6	6^{6}	7	7^{6}	8	8^{6}	9	9^{6}	10	10^{6}	11	11^{6}	12
7	1^{9}	2^{4}	2^{11}	3^{6}	4^{1}	4^{8}	5^{3}	5^{10}	6^{5}	7	7^{7}	8^{2}	8^{9}	9^{4}	9^{11}	10^{6}	11^{1}	11^{8}	12^{3}	12^{10}	13^{5}	14
8	2	2^{8}	3^{4}	4	4^{8}	5^{4}	6	6^{8}	7^{4}	8	8^{8}	9^{4}	10	10^{8}	11^{4}	12	12^{8}	13^{4}	14	14^{8}	15^{4}	16
9	2^{3}	3	3^{9}	4^{6}	5^{3}	6	6^{9}	7^{6}	8^{3}	9	9^{9}	10^{6}	11^{3}	12	12^{9}	13^{6}	14^{3}	15	15^{9}	16^{6}	17^{3}	18
10	2^{6}	3^{4}	4^{2}	5	5^{10}	6^{8}	7^{6}	8^{4}	9^{2}	10	10^{10}	11^{8}	12^{6}	13^{4}	14^{2}	15	15^{10}	16^{8}	17^{6}	18^{4}	19^{2}	20
11	2^{9}	3^{8}	4^{7}	5^{6}	6^{5}	7^{4}	8^{3}	9^{2}	10^{1}	11	11^{11}	12^{10}	12^{9}	14^{8}	15^{7}	16^{6}	17^{5}	18^{4}	19^{3}	20^{2}	21^{1}	22
12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
13	3^{3}	4^{4}	5^{5}	6^{6}	7^{7}	8^{8}	9^{9}	10^{10}	11^{11}	13	14^{1}	15^{2}	16^{3}	17^{4}	18^{5}	19^{6}	20^{7}	21^{8}	22^{9}	23^{10}	24^{11}	26
14	3^{6}	4^{8}	5^{10}	7	8^{2}	9^{4}	10^{6}	11^{8}	12^{10}	14	15^{2}	16^{4}	17^{6}	18^{8}	19^{10}	21	22^{2}	23^{4}	24^{6}	25^{8}	26^{10}	28
15	3^{9}	5	6^{3}	7^{6}	8^{9}	10	11^{3}	12^{6}	13^{9}	15	16^{3}	17^{6}	18^{9}	20	21^{3}	22^{6}	23^{9}	25	26^{3}	27^{6}	28^{9}	30
16	4	5^{4}	6^{8}	8	9^{4}	10^{8}	12	13^{4}	14^{8}	16	17^{4}	18^{8}	20	21^{4}	22^{8}	24	25^{4}	26^{8}	28	29^{4}	30^{8}	32
18	4^{6}	6	7^{6}	9	10^{6}	12	13^{6}	15	16^{6}	18	19^{6}	21	22^{6}	24	25^{6}	27	28^{6}	30	31^{6}	33	34^{6}	36
20	5	6^{8}	8^{4}	10	11^{8}	13^{4}	15	16^{8}	18^{4}	20	21^{8}	23^{4}	25	26^{8}	28^{4}	30	31^{8}	33^{4}	35	36^{8}	38^{4}	40
22	5^{6}	7^{4}	9^{2}	11	12^{10}	14^{8}	16^{6}	18^{4}	20^{2}	22	23^{10}	25^{8}	27^{6}	29^{4}	31^{2}	33	34^{10}	36^{8}	38^{6}	40^{4}	42^{2}	44
24	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
26	6^{6}	8^{8}	10^{10}	13	15^{2}	17^{4}	19^{6}	21^{8}	23^{10}	26	28^{2}	30^{4}	32^{6}	34^{8}	36^{10}	39	41^{2}	43^{4}	45^{6}	47^{8}	49^{10}	52
28	7	9^{4}	11^{8}	14	16^{4}	18^{8}	21	23^{4}	25^{8}	28	30^{4}	32^{8}	35	37^{4}	39^{8}	42	44^{4}	46^{8}	49	51^{4}	53^{8}	56
30	7^{6}	10	12^{6}	15	17^{6}	20	22^{6}	25	27^{6}	30	32^{6}	35	37^{6}	40	42^{6}	45	47^{6}	50	52^{6}	55	57^{6}	60
32	8	10^{8}	13^{4}	16	18^{8}	21^{4}	24	26^{8}	29^{4}	32	34^{8}	37^{4}	40	42^{8}	45^{4}	48	50^{8}	53^{4}	56	58^{8}	61^{4}	64

TO COMPUTE SIZES NOT GIVEN IN THE BOARD MEASURE TABLE

A great variety of sizes can be computed or checked by the aid of the foregoing table.

If you wish to figure the contents of fractional lumber. plank. square or rectangular timbers the table can be used for that purpose.

For lumber 1¼ inches in thickness add ¼ to the amount given in the table for a board of corresponding width and length.

For lumber 1½ inches in thickness you would add half the amount to the contents.

For lumber 2 inches in thickness double the amount of contents. In other words when the thickness exceeds one inch multiply the board feet amounts given in the table by the thickness.

EXAMPLES

Fractional Sizes—Find the contents of 1 piece 1¼x17. 20 feet long.

By referring to the table you will find 1 piece 1x17, 20 feet long. contains 28 feet and 4 inches. to this is added one quarter (7 ft. 1 in.) which gives 35 feet 5 inches. the board feet contents of 1 piece 1¼x17, 20 feet long.

If the board were 1½ inches in thickness you would add to the contents of 1x17, half the amount.

Square timbers—Find the contents of 1 piece 18x18. 20 feet long.
According to the table. 1 piece 1x18 20 contains 30 board feet. the amount multiplied by one side of the square (18) gives 540, the board feet contents.

Rectangular Timbers—Find the contents of 1 piece 15x24 32 feet long.

In this case you can multiply the contents of 1x15 32 (40 feet contents) by 24, or 1x24 32 (64 feet contents) by 15, the result will be the same, namely 960 board feet contents.

Totals—In the table the fractions are given in twelfths (small figures) making adding easier. Thus the following 1 inch lumber would be added:

1 piece 1x 7—10 ft. equals	5 ft. 10 ins.
1 piece 1x10—12 ft. equals	10 ft. 0 ins.
1 piece 1x16—12 ft. equals	16 ft. 0 ins.
1 piece 1x13—14 ft. equals	15 ft. 2 ins.
1 piece 1x20—16 ft. equals	26 ft. 8 ins.

Total equals 72 and 20/12 ft., or 73⅔ board ft.

To find the total contents of lumber thicker than 1 inch, proceed as if the lumber were 1 inch and multiply the total by the thickness.

In the foregoing example, if it were 3-inch lumber the total would be multiplied by 3, or a total of 221 board feet.

TO COMPUTE AN AVERAGE RANGE OF LENGTHS

When an order such as 3x8 and wider calls for an average length, use the following system to compute it:

Rule:

Add together the total pieces of each length, and multiply the pieces by their respective lengths; then add separately the pieces and lengths, and divide the grand total of pieces into the grand total of lengths. The result will be the average length.

Example:

Find the average length of a range of widths such as 3x8 and wider.

Process:

Pieces	Length	Lin. Ft.
23	multiplied by 16 ft. equal	368
9	multiplied by 18 ft. equal	162
34	multiplied by 20 ft. equal	680
79	multiplied by 22 ft. equal	1738
12	multiplied by 24 ft. equal	288
11	multiplied by 26 ft. equal	286
8	multiplied by 28 ft. equal	224
7	multiplied by 30 ft. equal	210
7	multiplied by 32 ft. equal	224
190	Pieces, divided into	4180

gives 22 feet, the average length.

TO COMPUTE AVERAGE WIDTHS

Orders from Europe frequently call for an average in width of a specified thickness, such as 3x8 and wider, 4x10 and wider, 6x12 and wider. The following is the system for striking an average:

Rule:

Multiply the total pieces of each width separately; then add totals separately, and divide total of pieces into total of widths. The result will be the average width.

Example:

An item on an order calls for a specified amount of 4x10 and wider, to average 15 inches or over in width. The following pieces and widths have been sawn on this item; what is the present average?

Process:

Total Pieces		Each Width		Totals of Pieces and Width's Multiplied
16	x	10	equals	160
24	x	11	equals	264
20	x	12	equals	240
42	x	13	equals	546
30	x	14	equals	420
40	x	15	equals	600
50	x	16	equals	800
20	x	18	equals	360
48	x	20	equals	960
290		Pieces, divided into		4350

equals 15 inches, the average width required.

BOARD MEASUREMENT OF LOGS

Board measure is designed primarily for the measurement of sawed lumber. The unit is the board foot, which is a board 1 inch thick and 1 foot square, so that with inch boards the content in board measure is the same as the number of square feet of surface; with lumber of other thicknesses the content is expressed in terms of inch boards.

In recent years board measure has been used as a unit of volume for logs. When so applied the measure does not show the entire content of the log, but the quantity of lumber which, it is estimated, may be manufactured from it. The number of board feet in any given log is determined from a table that shows the estimated number which can be taken out from logs of different diameters and lengths. Such a table is called a log scale or log rule, and is compiled by reducing the dimensions of perfect logs of different sizes, to allow for waste in manufacture, and then calculating the number of inch boards which remain.

The amount of lumber which can be cut from logs of a given size is not uniform, because the factors which determine the amount of waste vary under different circumstances, such as the thickness of the saw, the thickness of the boards, the width of the smallest board which may be utilized, the skill of the sawyer, the efficiency of the machinery, the defects in the log, the amount of taper, and the shrinkage. This lack of uniformity has led to wide differences of opinion as to how log rules should be constructed. There have been many attempts to devise a log rule which can be used as a standard, but none of them will meet all conditions. The rules in existence have been so unsatisfactory that constant attempts have been made to improve upon them. As a result there are now actually in use in the United States 40 or 50 different log rules, whose results differ in some cases as much as 120 per cent for 20-inch to 30-inch logs, and 600 per cent for 6-inch logs. Some of these are constructed from mathematical formulae; some by preparing diagrams that represent the top of a log and then determining the amount of waste in sawdust and slabs; some are based on actual averages of logs cut at the mill; while still others are the result of making corrections in an existing rule to meet special local conditions.

The large number of log rules, the differences in their values, and the variation in the methods of their application have led to much confusion and inconvenience. Efforts to reach an agreement among lumbermen on a single standard log rule have failed so far. A number of States have given official sanction to specific rules, but this has only added to the confusion, because the States have not chosen the same rule, so there are six different state log rules, and, in addition, three different official log rules in Canada. It is probable that a standard method of measuring logs will not be worked out satisfactorily until a single unit of volume, like the cubic or board foot, is adopted for the measurement of logs.—U. S. Forest Service Bulletin 36.

The Brereton Solid Log Table shows the exact or solid contents in board feet of logs or round timbers, which will be found invaluable in a large number of instances as enumerated in the following pages, and also for comparison with the Pacific Coast and other numerous log scales now in use.

It is only a question of time when both buyer and seller will recognize the absolute fairness and benefit to be derived from making sales on the exact contents of a log, as the variation in quality can then be adjusted by the variation in price.

It is unreasonable to measure pulp wood logs in terms of manufactured lumber, as the entire log is used in making pulp. Therefore a solid measure is more appropriate than the usual log scale making allowance for slab and saw kerf.

ADVANTAGES AND USES OF THE BRERETON SOLID LOG TABLE SHOWING EXACT BOARD MEASURE CONTENTS OF LOGS

Situations arise where it is essential to arrive at a close estimate for freight purposes of the exact or solid contents of logs or piling which are often shipped by vessel to Foreign or Domestic ports or when it is necessary to compute their weight prior to shipping by rail, with a view of ordering cars that will stand the strain of heavy and long logs, spars or timbers.

It is also indispensable for ship's officers and stevedores to know the contents and weight of large logs and spars to enable them to judge as to the advisability of adjusting or doubling up their gear to avoid smashing derricks and winches or otherwise breaking down machinery.

POUNDS PER DEADWEIGHT TON

When computing deadweight of lumber, coal, or general cargo carried by British vessels, it is customary to use the long ton of 2240 pounds.

WEIGHT OF DOUGLAS FIR LOGS OR PILING

Rafted logs or piling on account of being partly submerged in salt or fresh water, or freshly felled in the early summer months, will naturally weigh more than those felled in winter, or shipped direct on cars from forest to destination. To compute the approximate weight in pounds of rafted logs or piling, take average diameter including bark, then ascertain board measure contents by referring to the Brereton Solid Log Table and multiply the amount by 3.5.

For logs and piling shipped on cars multiply board measure contents by 3.4.

WEIGHT OF CREOSOTED DOUGLAS FIR PILES, POLES AND TIES

To compute weight in pounds of creosoted piles or poles, take average diameter, then ascertain board measure contents according to the Brereton Solid Log Table and multiply the amount by 3.5.

Butt treated or butt and top treated telephone, telegraph or electric light poles weigh about 3.4 pounds per board foot, exact contents.

Creosoted ties (sleepers) or lumber of small dimensions weigh about 3.6 pounds per board foot. Creosoted timbers weigh about 3.5 pounds per board foot.

POINTER FOR CHARTERER OR OWNERS OF VESSELS—TAINT FROM CREOSOTE

In making charters for vessels to carry creosoted piling or lumber, if possible arrange to carry this material on deck. If carried under deck it will taint perishable cargo in same compartment, or perishable cargo carried on the return voyage.

EFFECT OF CREOSOTE ON CARRYING CAPACITY

The difference in weight between creosoted and untreated ties must also be taken into consideration as this affects the carrying capacity to a considerable extent; for instance, a steamer with a deadweight cargo carrying capacity of 5400 long tons that would ordinarily carry 3,620,000 board feet of untreated fir ties would only carry 3,360,000 board feet of creosoted ties, a difference of 260,000 board feet.

GROWTH OF TREES

Since there is a marked tendency among timberland owners to cut their timber with an eye to the future, some knowledge of the growth of forest trees becomes important.

Trees grow by adding each year a layer of wood underneath the bark. Since each year contains only one growing season and the spring and summer part of this layer are not alike, each year's growth. layer, or "annual ring" usually is distinguishable. The central fact of tree growth is that each ring means a year. The exceptions to this are not important enough to merit notice here.

Trees growing in the heart of the forest are generally straight and tall as it is necessary for their leaves to receive sunlight and air sufficient for vitalizing the sap; the lower branches of these trees only last a few years when they die and fall off. On the edges of the forest the lower branches of the trees remain alive and active so that timber cut from such places is knotty and occasionally cross-grained, while that cut from the inside trees is straight-grained and contains a larger percentage of clear lumber.

ANNUAL RINGS

Annual rings denote the spring and summer growth of the tree; the spring ring is distinguished by its light color; it is invariably wider than the summer ring on account of its more rapid growth which produces a softer fiber. The summer ring is darker in color, is harder and has a much more solid appearance than the spring ring. The line of separation in annual rings is caused by the suspension of the growth of the stem during winter.

The annual rings are not always uniform as they are generally thicker on that side of the tree which has the longest exposure to the sun. For this reason the distance from pith to bark will often vary several inches; for instance, the measurement of a log from heart center to bark would be, say 15 inches on one side and 20 inches on the other.

The widest rings are found around the heart centre from whence they gradually diminish in thickness as they radiate towards the sap, where their growth is so compact that it is almost impossible to count them without the aid of a microscope.

In determining the strength of lumber which is the principal point when inspecting the merchantable grades generally used for high class constructional purposes, the width, uniformity and compactness of the growth of the annual rings should be carefully noted. When the summer ring is narrow and the spring ring wide or porous, weakness is the result. When the spring and summer rings are nearly equal in width and uniformly close, it denotes natural strength so requisite in the quality of lumber used for ship and bridge work, masts, spars, dredger spuds, derricks or similar purposes for which Douglas Fir is unequalled.

In small trees the annual rings are proportionately closer and more uniform from heart centre to bark than the larger species, though there are occasional exceptions.

The annual rings are larger at the top than at the base of tree.

Small and medium sized logs which range from 17 to 36 inches in diameter, as a rule produce excellent timbers and a good grade of merchantable lumber.

ANNUAL RINGS DENSITY AND DECAY

Specific gravity or density of lumber materially influences resistance to decay of the heart-wood; the more dense the wood the more durable it is. Specific gravity is a property which can not be determined from inspection, but it can be estimated by recourse to the proportion of summerwood to springwood in the annual growth rings which proves to be a safe criterion of the durability of heartwood; i. e., an increase in summer wood results in an increase in specific gravity. The specific gravity of Douglas Fir when freshly sawn is 640.

The width of the growth rings furnishes a further index of durability; the summer wood, which is of greater density and contains more pitch, shows more resistance to fungus attack than the spring rings of porous growth.

The resisting qualities of pitch to decay is principally through its waterproofing effect on wood, and thus its influence on the absorption of moisture by wood containing it; that is, the power of wood to absorb moisture is very important in its decay. It is well known that below a certain maximum of moisture in wood, fungi will not grow. Any property of the wood which will influence this balance of moisture is of importance in decay resistance. Thus, if the wood contains enough pitch to have a material waterproofing effect, it must play a role in durability.

DURABILITY OF WOOD

Timber cut in spring or in summer is not so durable as that cut in winter, when the life processes of trees are less active. Scientific investigations sustain this statement. The durability depends not only upon the greater or less density but also upon the presence of certain chemical constituents in the wood. Thus a large proportion of resinous matter increases the durability, while the presence of easily soluble carbohydrates diminishes it considerably.

During the growing season the wood of trees contains sulphuric acid and potassium, both of which are solvents of carbohydrates, starch, resins and gums; they are known to soften also the ligneous tissue to a considerable degree. During the summer months the wood of living trees contains eight times as much sulphuric acid and five times as much potassium as it does during the winter months. The presence of these two chemical substances during the growing season constitutes the chief factor in dissolving the natural preservatives within the wood and in preparing the wood for the different kinds of wood-destroying fungi, such as polyporus and agaricus. The fungi can thus penetrate more quickly and easily into the interior of the wood when these wood gums are already partly dissolved and available for their own immediate use.

From this standpoint it seems that the best time to cut down the tree is in the winter, when sulphuric acid and potassium are present to a much smaller degree, and the fungi will not be assisted in dissolving the natural preservatives in the wood. The amount of wood gum is always less and more easily soluble in sapwood than in heartwood.—Scientific American.

OLD GROWTH LOGS

In reference to lumber manufactured from "old growth" logs, it means that the trees from which they were logged are mature, of large diameter and grown in a virgin forest, and not from trees in a process of decay through age.

Old growth Douglas Fir furnishes excellent lumber for high grade wide clears, in either edge or slash grain.

DIAMETER GROWTH

Some trees grow so slowly that a hand lens is necessary to clearly distinguish the rings, others may have rings a half inch in width. In any case, a little practice improves the ability to note all the rings.

To find the age of a felled tree at any section, then, requires only the accurate counting of the rings. The total age of the tree is shown by the total number of rings at the ground; or the total number of rings on the stump plus the number of years required to grow as high as the stump. An examination of a number of small trees would give an idea of the time required to grow up to stump height. This varies from one year in trees coming up as stump sprouts to as high as twenty years or more in some Rocky Mountain conifers, for heights of 1 to 3 feet.

Since trees often grow faster on one side than another, the average growth is gotten only by finding the average radius and counting and measuring the rings along it. Thus the radius of the tree may be found at ten, twenty, thirty years, etc., and by doubling these the diameters are found at these ages.

DIFFERENTIAL TABLE

Table showing difference in board feet between actual contents of logs, 40 feet in length, 12 to 40 inches in diameter, and the Pacific Coast Log Scale's; also their respective allowances for slabs and saw kerf.

	12-in. Diam.	Allowance for Slabs and Saw Kerf.	14-in. Diam.	Allowance for Slabs and Saw Kerf.	16-in. Diam.	Allowance for Slabs and Saw Kerf.
Actual Contents	589	....	757	....	945	....
Scribner Scale	196	393	286	471	396	549
Spaulding Scale	192	397	286	471	402	543
British Columbia Scale	210	379	297	460	400	545

	18-in. Diam.	Allowance for Slabs and Saw Kerf.	20-in. Diam.	Allowance for Slabs and Saw Kerf.	22-in. Diam.	Allowance for Slabs and Saw Kerf.
Actual Contents	1155	....	1385	....	1636	....
Scribner Scale	534	621	700	685	836	800
Spaulding Scale	540	615	690	695	852	784
British Columbia Scale	518	637	652	733	800	836

	24-in. Diam.	Allowance for Slabs and Saw Kerf.	26-in. Diam.	Allowance for Slabs and Saw Kerf.	28-in. Diam.	Allowance for Slabs and Saw Kerf.
Actual Contents	1909	....	2202	....	2516	....
Scribner Scale	1010	899	1250	952	1456	1060
Spaulding Scale	1030	879	1220	982	1422	1094
British Columbia Scale	964	945	1145	1057	1337	1179

	30-in. Diam.	Allowance for Slabs and Saw Kerf.	32-in. Diam.	Allowance for Slabs and Saw Kerf.	34-in. Diam.	Allowance for Slabs and Saw Kerf.
Actual Contents	2851	....	3207	....	3584	....
Scribner Scale	1642	1209	1840	1367	2000	1584
Spaulding Scale	1640	1211	1870	1337	2112	1472
British Columbia Scale	1546	1305	1771	1436	2011	1573

	36-in. Diam.	Allowance for Slabs and Saw Kerf.	38-in. Diam.	Allowance for Slabs and Saw Kerf.	40-in. Diam.	Allowance for Slabs and Saw Kerf.
Actual Contents	3982	....	4401	....	4841	....
Scribner Scale	2304	1678	2670	1731	3010	1831
Spaulding Scale	2376	1606	2660	1741	2962	1879
Briitsh Columbia Scale	2266	1716	2536	1865	2822	2019

TAPER OF DOUGLAS FIR LOGS

The foregoing table is computed on the assumption that the 40-foot logs used as an example have an increase in taper of 6 inches, which is a fair average for this length of log.

To gauge the correct actual contents of a log, it is necessary to take the mean diameter, not the diameter at the small end, which is the usual method of scaling Douglas Fir logs; therefore to arrive at the actual contents given in the table, an increase of three inches over the diameter at the small end is allowed to give the correct mean diameter upon which the actual contents given in this table are based.

To display that the increase of 6 inches in taper is not excessive or used for the purpose of creating a disparity between the actual contents of logs as shown in the "Differential Table" and the scale according to log rules; carefully note in the following table the increase in taper of Douglas Fir logs from records kept by the United States Forest Service Department.

TAPER OF DOUGLAS FIR LOGS

Total Length Feet	Butt Log	Log Lengths Second Log	Third Log	Top Log
80	28′	26′	..	26′
Increase	7″	5″	...	0″
82	28′	28′	...	26′
Increase	7″	5″	...	0″
84	28′	28′	...	28′
Increase	8″	5″	...	0″
86	30′	28′	...	28′
Increase	8″	5″	...	0″
88	30′	30′	...	28′
.. Increase	8″	5″	...	0″
90	30′	30′	...	30′
Increase	8″	6″	...	0″
92	32′	30′	...	30′
Increase	8″	6″	...	0″
94	32′	32′	...	30′
Increase	8″	6″	...	6″
96	32′	32′	...	32′
Increase	9″	6″	...	0″
98	26′	24′	24′	24′
Increase	9″	8″	5″	0″
100	26′	26′	24′	24′
Increase	10″	8″	5″	0″

This table is intended to be used simply as a guide; the allowances for taper shown should be varied to conform to the actual taper. These figures are based on the actual taper of 110 Douglas Fir trees of average height measured in Washington and Oregon.

AVERAGE CONTENTS OF LOGS

To enable loggers and lumbermen to arrive at the average board feet in Douglas Fir and other species of Pacific Coast logs, with a view of comparing the difference between the solid or actual contents of logs, and the amounts according to the log rules in general use, the following table covers a record of the number of logs scaled and their contents, during the years 1913, 1914, 1915, 1916 and 1917, by the Puget Sound Log Scaling and Grading Bureau, Everett, Wash.

In the five years mentioned this Bureau scaled 4,604,000 logs containing 3,353,631,600 board feet. If the foregoing had been scaled according to their solid contents; i. e., without allowance for saw kerf and slab, the result would be about double the amount stated.

A fact that should not be lost sight of when comparing the difference between the solid contents and the amounts given in the standard log tables, is that the present method of scaling logs is invariably to take the diameter at the small end of the log, whereas in computing the solid contents, the mean or diameter at center of log is taken.

Table showing contents in board feet of an average log of Douglas Fir, Hemlock, Spruce, Cedar and miscellaneous species. Scaled by Puget Sound Log Scaling and Grading Bureau.

	Number of Logs.	Board Feet Scale.	Log Average.	Pctg.
No. 1 Douglas Fir	92,671	256,496,830	2768	13
No. 2 Douglas Fir	1,044,589	1,123,440,220	1074	55
No. 3 Douglas Fir	1,184,594	659,725,000	556	32
Total Douglas Fir........	2,321,854	2,039,662,050	878	61
Western Hemlock	635,838	303,023,270	476	09
Sitka Spruce	100,973	104,959,880	1039	03
Western Cedar	1,457,906	856,888,890	588	26
***Miscellaneous**	87,429	49,097,510	564	01
Total	4,604,000	3,353,631,600	728	

*Miscellaneous includes the following: White Pine, White Fir, Maple, Cottonwood and Boomsticks.

BRERETON SOLID LOG TABLE

ACTUAL CONTENTS OF LOGS OR ROUND TIMBERS IN BOARD FEET

Length in Feet	Average Diameter in Inches										
	6	7	8	9	10	11	12	13	14	15	16
16	38	51	67	85	105	127	151	177	205	236	268
18	42	58	75	95	118	143	170	199	231	265	302
20	47	64	84	106	131	158	188	221	257	295	335
22	52	71	92	117	144	174	207	243	282	324	369
24	57	77	101	127	157	190	226	265	308	353	402
26	61	83	109	138	170	206	245	288	334	383	436
28	66	90	117	148	183	222	264	310	359	412	469
30	71	96	126	159	196	238	283	332	385	442	503
32	75	103	134	170	209	253	302	354	411	471	536
34	80	109	142	180	223	269	320	376	436	501	570
36	85	115	151	191	236	285	339	398	462	530	603
38	90	122	159	201	249	301	358	420	487	560	637
40	94	128	168	212	262	317	377	442	513	589	670
42	99	135	176	223	275	333	396	465	539	619	704
44	104	141	184	233	288	348	415	487	564	648	737
46	108	148	193	244	301	364	434	509	590	677	771
48	113	154	201	254	314	380	452	531	616	707	804
50	118	160	209	265	327	396	471	553	641	736	838
52	123	167	218	276	340	412	490	575	667	766	871
54	127	173	226	286	353	428	509	597	693	795	905
56	132	180	235	297	367	443	528	619	718	825	938
58	137	186	242	307	380	459	547	642	744	854	972
60	141	192	251	318	393	475	565	664	770	884	1005

BRERETON SOLID LOG TABLE—Continued

ACTUAL CONTENTS OF LOGS OR ROUND TIMBERS IN BOARD FEET

Length in Feet	Average Diameter in Inches										
	17	18	19	20	21	22	23	24	25	26	27
16	303	339	378	419	462	507	554	603	655	708	763
18	340	382	425	471	520	570	623	679	736	796	859
20	378	424	473	524	577	634	692	754	818	885	954
22	416	467	520	576	635	697	762	829	900	973	1050
24	454	509	567	628	693	760	831	905	982	1062	1145
26	492	551	614	681	750	824	900	980	1064	1150	1241
28	530	594	662	733	808	887	969	1056	1145	1239	1336
30	567	636	709	785	866	950	1039	1131	1227	1327	1431
32	605	679	756	838	924	1014	1108	1206	1309	1416	1527
34	643	721	803	890	981	1077	1177	1282	1391	1504	1622
36	681	763	851	942	1039	1140	1246	1357	1473	1593	1718
38	719	806	898	995	1097	1204	1316	1433	1554	1681	1813
40	757	848	945	1047	1155	1267	1385	1508	1636	1770	1909
42	794	891	992	1100	1212	1330	1454	1583	1718	1858	2004
44	832	933	1040	1152	1270	1394	1523	1659	1800	1947	2099
46	870	975	1087	1204	1328	1457	1593	1734	1882	2035	2195
48	908	1018	1134	1257	1385	1521	1662	1810	1964	2124	2290
50	964	1060	1181	1309	1443	1584	1731	1885	2045	2212	2386
52	984	1103	1229	1361	1501	1647	1800	1960	2127	2301	2481
54	1021	1145	1276	1414	1559	1711	1870	2036	2209	2389	2577
56	1059	1188	1323	1466	1616	1774	1939	2111	2291	2478	2672
58	1097	1230	1370	1518	1674	1837	2008	2187	2373	2566	2767
60	1135	1272	1418	1571	1732	1901	2077	2262	2454	2655	2863

BRERETON SOLID LOG TABLE—Continued

ACTUAL CONTENTS OF LOGS OR ROUND TIMBERS IN BOARD FEET

Length In Feet	Average Diameter in Inches										
	28	29	30	31	32	33	34	35	36	37	38
16	821	881	942	1006	1072	1140	1211	1283	1357	1434	1512
18	924	991	1060	1132	1206	1283	1362	1443	1527	1613	1701
20	1026	1101	1178	1258	1340	1426	1513	1604	1696	1792	1890
22	1129	1211	1296	1384	1474	1568	1665	1764	1866	1971	2079
24	1232	1321	1414	1510	1608	1711	1816	1924	2036	2150	2268
26	1334	1431	1532	1635	1743	1853	1967	2085	2205	2330	2457
28	1437	1541	1649	1761	1877	1996	2118	2245	2375	2509	2646
30	1539	1651	1767	1887	2011	2138	2270	2405	2545	2688	2835
32	1642	1761	1885	2013	2145	2281	2421	2566	2714	2867	3024
34	1745	1871	2003	2139	2279	2423	2572	2726	2884	3046	3213
36	1847	1982	2121	2264	2413	2566	2724	2886	3054	3226	3402
38	1950	2092	2238	2390	2547	2708	2875	3047	3223	3405	3591
40	2053	2202	2356	2516	2681	2851	3026	3207	3393	3584	3780
42	2155	2312	2474	2642	2815	2994	3178	3367	3563	3763	3969
44	2258	2422	2592	2767	2949	3136	3329	3528	3732	3942	4158
46	2360	2532	2710	2893	3083	3279	3480	3688	3902	4122	4347
48	2463	2642	2827	3019	3217	3421	3632	3848	4072	4301	4536
50	2566	2752	2945	3145	3351	3564	3783	4009	4241	4480	4725
52	2668	2862	3063	3271	3485	3706	3934	4169	4411	4659	4915
54	2771	2972	3181	3396	3619	3849	4086	4330	4580	4838	5104
56	2874	3082	3299	3522	3753	3991	4237	4490	4750	5018	5293
58	2976	3193	3416	3648	3887	4134	4388	4650	4920	5197	5482
60	3079	3303	3534	3774	4021	4277	4540	4811	5089	5376	5671

BRERETON SOLID LOG TABLE—Continued

ACTUAL CONTENTS OF LOGS OR ROUND TIMBERS IN BOARD FEET

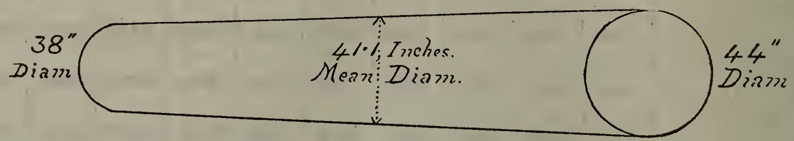
Length In Feet	Average Diameter in Inches									
	39	40	41	42	43	44	45	46	47	48
16	1593	1676	1760	1847	1936	2027	2121	2216	2313	2413
18	1792	1885	1980	2078	2178	2281	2386	2493	2602	2714
20	1991	2094	2200	2309	2420	2534	2651	2770	2892	3016
22	2190	2304	2420	2540	2662	2788	2916	3047	3181	3318
24	2389	2513	2641	2771	2904	3041	3181	3324	3470	3619
26	2588	2723	2861	3002	3146	3294	3446	3601	3759	3921
28	2787	2932	3081	3233	3388	3548	3711	3878	4048	4222
30	2986	3142	3301	3464	3631	3801	3976	4155	4337	4524
32	3186	3351	3521	3695	3873	4055	4241	4432	4627	4825
34	3385	3560	3741	3925	4115	4308	4506	4709	4916	5127
36	3584	3770	3961	4156	4357	4562	4771	4986	5204	5429
38	3783	3979	4181	4387	4599	4815	5036	5263	5494	5730
40	3982	4189	4401	4618	4841	5068	5301	5540	5783	6032
42	4181	4398	4621	4849	5083	5322	5567	5817	6072	6333
44	4380	4608	4841	5080	5325	5575	5832	6094	6361	6635
46	4579	4817	5061	5311	5567	5829	6097	6371	6651	6937
48	4778	5027	5281	5542	5809	6082	6362	6648	6940	7238
50	4977	5236	5501	5773	6051	6336	6627	6925	7229	7540
52	5177	5445	5721	6004	6293	6589	6892	7202	7518	7841
54	5376	5655	5941	6235	6535	6842	7157	7479	7807	8143
56	5575	5864	6161	6465	6777	7096	7422	7756	8096	8445
58	5774	6074	6381	6696	7019	7349	7687	8033	8386	8746
60	5973	6283	6601	6927	7261	7603	7952	8310	8675	9048

TO COMPUTE CONTENTS OF A LOG, ROUND TAPERING TIMBER OR FRUSTUM OF A CONE

To compute the board feet contents of a log, round tapering timber or frustum of a cone.

Rule:

Add together squares of the diameters of the smaller and larger ends and product of the two diameters; multiply their sum respectively by .7854, and this product by length (height); then divide result by 12 and 3.



Example:

Find the board feet contents of a log 38 inches diameter at the small end, and 44 inches diameter at the large end, 40 feet in length.

Process:

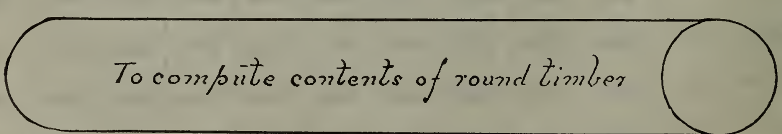
(Small diam)	38 x 38 equals	1444
(Large diam)	44 x 44 equals	1936
(Both diam's)	38 x 44 equals	1672
		5052
Sum of diameters by		.7854
		20208
		25260
		40416
		35364
		3967.8408
Multiplied by		40
Divided by		12)158713.6320
Divided by		3) 13226.1360
		4408.7120 Board Feet, Contents

The exact mean diameter of the log in the foregoing example is 41.1 inches, not 41 inches as would be generally supposed. The difference is due to the converging slant height of a tapering body which gives a very slight increase in mean diameter over the approximate diameter which is computed by adding the top and bottom diameter together and dividing by 2.

When the diameter of a round timber is given or the mean diameter of a log is known the board feet contents can be obtained by referennce to the Actual Contents Table, or using the following rule.

Rule:

Multiply the square of the diameter by .7854, and the product by the length, then divide by 12.



Example:

Find the board measure contents of a round timber 20 inches diameter and 50 feet in length.

Process:

Square of diam. 20 x 20 equals 400.
400 multiplied by .7854 equals 314.16
314.16 multiplied by length 50 ft., equals 15708
15708 divided by 12 equals 1309, Board Feet.

COMPUTING CONTENTS OF LOGS BY CIRCUMFERENCE

When the mean circumference of a log or round timber is known, the following rule gives the actual board measure contents.

Rule:

Multiply the square of the circumference by twice the length and divide by 300.

Example:

Find the actual board measure contents of a log 60 inches mean circumference and 50 feet in length.

Process:

60 x 60 equals 3600, the square of the circumference.
3600 x 100, (twice 50, the length,) equals 360,000.
360,000 divided by 300 equals 1200, the board measure contents.

Note:

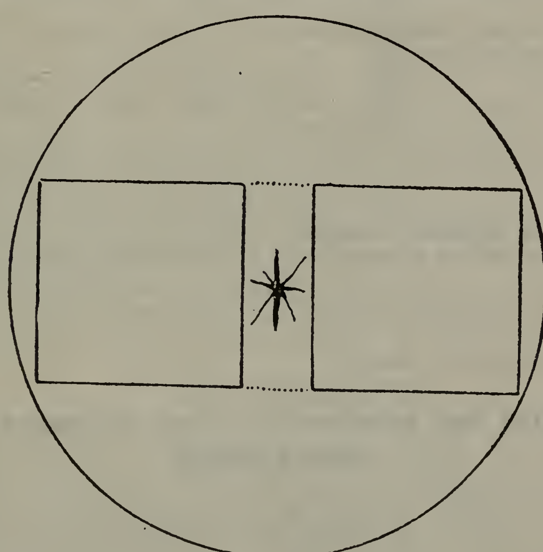
The foregoing rule gives five feet more lumber in every thousand feet a log contains than if computed by the long and tedious rule of geometry and is sufficiently correct for all practical purposes.

The circumference of a log or circle multiplied by 0.31831 will give the diameter.

The diameter multiplied by 3—1/7 or for greater "accuracy" by 3.1416 will give the circumference of a log or circle.

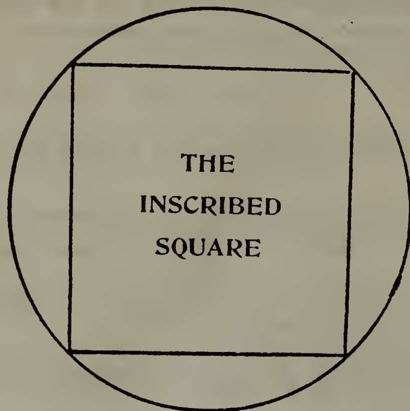
HOW TO SAW TIMBERS

Diagram Illustrating Correct Method of Making Two Timbers Out of a Log



When it is necessary to make two sound timbers out of a large log, splitting through the heart should always be avoided, and if the following system is adopted better timbers will be produced, and the danger of exposing heart shakes will be greatly minimized.

Presume it is necessary to make two 12x12 timbers out of a log 32 inches in diameter. Square up a 12x28½ (the ½ inch allows for two cuts ¼ inch Kerf), then cut the first timber, and if free from heart shakes, turn cant over and saw off 4 inches, and you will then have the second timber on the carriage. If after the first cut, shakey heart or other defects are exposed, without turning cant make another cut of 4 inches, which leaves a 12x12 on the carriage, and a glance will show whether it is suitable or not for required order.



To find the diameter of a log to make a square timber, divide one side of square by .707, or for practical purposes add a cipher to one side of square and divide by 7.

To find the largest size square timber that can be made out of a log, multiply diameter by 7 and divide by 10.

Examples:

What is the diameter of a log that will make a timber 21 inches square.

Process:

```
    21
    10
   ----
 7)210
   ----
    30 inches diameter.   Answer.
```

What size timber can be made out of a log 40 inches in diameter?

```
    40
     7
   ----
10)280
   ----
    28 inches square.   Answer.
```

TABLE SHOWING THE DIAMETER OF A LOG NECESSARY TO MAKE A SQUARE TIMBER

Diameter of log.	Size of Timber.	Diameter of log.	Size of Timber.
14½	10x10	34	24x24
16	11x11	35½	25x25
17	12x12	37	26x26
18½	13x13	38½	27x27
20	14x14	40	28x28
21½	15x15	41½	29x29
23	16x16	42½	30x30
24½	17x17	44	31x31
25½	18x18	45½	32x32
27	19x19	47	33x33
28½	20x20	48½	34x34
30	21x21	49½	35x35
31½	22x22	50½	36x36
33	23x23		

KNOTS AND HOW THEY ARE CLASSIFIED

DOUGLAS FIR

A Pin Knot does not exceed half inch in diameter.

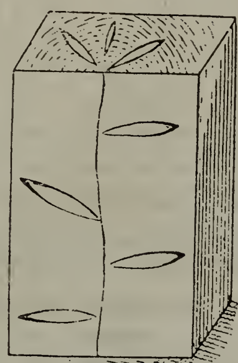
Round Knots are of a circular or oval formation, the average measurement across the face being considered the diameter.

Spike and Slash Knots are the same, and mean that the knot is sawn in a lengthwise direction.

Encased Knots usually are found in upper stock and are recognized by the ring of pitch which surrounds them; the knots on the outside of a plank may be encased, while on the heart side they are solid.

A thorough knowledge of knots is essentially of the utmost importance when grading lumber.

Knots spring from the heart in the same direction as the spokes do from the hub of a wheel.



The above illustration shows a 6 x 12 that has been sawn through the heart; the knots shown are classified as spike or slash.

The majority of knots are black at outside point, and encased about one-third the distance from outside point to the heart center.

The encased knots that penetrate lumber of one inch in thickness are liable to come out when seasoned and then surfaced; the damage is mostly caused by the force of the knife striking and loosening some of the knots as the board passes through the planer.

In lumber two inches and over in thickness, and of number 1 and 2 Merchantable grade, it is only in very rare instances that the knots come out.

Special attention should be paid to the grain surrounding the knots, and the direction it takes, as this indicates more than anything else the strength of the piece.

THE DOYLE RULE

The Doyle Rule is variously known as the Connecticut River Rule, the St. Croix Rule, the Thurber Rule, the Moore and Beeman Rule, and the Scribner Rule—the last name due to the fact that it is now printed in Scribner's Lumber and Log Book. It is used throughout the entire country, and is more widely employed than any other rule. **It is constructed by deducting 4 inches from the small diameter of the log as an allowance for slab, squaring one-quarter of the remainder, and multiplying the result by the length of the log in feet.**

The important feature of the formula is that the width of slab is always uniform, regardless of the size of the log. This waste allowance is altogether too small for large logs and is excessive for small ones. The principal is mathematically incorrect, for the product of perfect logs of different sizes follows an entirely different mathematical law, and it is, therefore, astonishing that this incorrect rule, which gives wrong results for both large and small logs, should have so general a use.

Where the loss by defects in the timber and waste in milling have accidentally about balanced the inaccuracies of the rule, fairly accurate results have been obtained. Frequently, however, mill men recognize the shortcomings of the rule and make corrections to meet their special requirements. In general, the mill cut overruns the Doyle log scale by about 25 per cent. for short logs 12 to 20 inches in diameter; and for long logs with a small top diameter the overrun is very much higher.

DESCRIPTION OF BRITISH COLUMBIA LOG SCALE

AS AUTHORIZED BY THE BRITISH COLUMBIA GOVERNMENT

Deduct one and a half inches from the mean diameter in inches at the small end of the log.

Square the result and multiply by .7854 to find area.

Deduct three elevenths.

Divide by 12 to bring to board measure and multiply by the length of the log in feet.

The above is intended to apply to all logs whose length is not greater than 40 feet.

It is further provided that in cases of logs over 40 feet in length an allowance on half the length of the log is made, in order to compensate for the increase in diameter; this allowance consists of an increase in the mean diameter at the small end of one inch for each additional 10 feet in length over 40 feet. In other words, in cases of logs from 42 to 50 feet long the contents of half the length of the log are to be computed according to the mean diameter at the small end, the contents of the other half of the log according to a diameter one inch greater than the mean diameter at the small end; in cases of logs from 52 to 60 feet long, the contents of half the log according to the mean diameter at the small end, and those of the other half according to a diameter two inches greater than the mean at the small end, and so on; the contents of the second half to be computed according to a diameter one inch greater than that of the mean at the small end for each additional 10 feet in length after 40 feet.

It was not, however, considered necessary to extend the table for a length of log greater than 40 feet, as the contents of such a log of given diameter may be obtained with sufficient accuracy by adding the tabular contents of half the length of the log at the given diameter to the tabular contents of a similar log at a diameter increased one inch for each additional 10 feet in length beyond 40 feet.

AS PROVIDED UNDER SECTION 6 OF THE "ROYALTY ACT."

Cedar

No. 1.—Logs 16 feet and over in length, 20 inches and over in diameter, that will cut out 50 per cent. or over of their scaled contents in clear inch lumber: Provided that in cases of split timber the foregoing diameter shall not apply as the minimum diameter for this grade.

No. 2.—Shingle grade. Logs not less than 16 inches in diameter and not less than 16 feet in length that are better than No. 3 grade, but not grade No. 1.

No. 3.—Rough logs or tops suitable only for shiplap or dimension.

Culls.—Logs lower in grade than No. 3 shall be classed as culls.

Douglas Fir

No. 1.—Logs suitable for flooring, reasonably straight, not less than 20 feet long, not less than 30 inches in diameter, clear, free from such defects as would impair the value for clear lumber.

No. 2.—Logs not less than 14 inches in diameter, not over 24 feet long or not less than 12 inches in diameter, and over 24 feet, sound, reasonably straight, free from rotten knots or bunch-knots, and the grain straight enough to ensure strength.

No. 3.—Logs having visible defects, such as bad crooks, bad knots, or other defects that would impair the value and lower the grade of lumber below merchantable.

Culls.—Logs lower in grade than No. 3 will be classed as culls.

Spruce, Pine, and Cottonwood

No. 1.—Logs 12 feet and over in length, 30 inches in diameter and over up to 32 feet long, 24 inches if over 32 feet long, reasonably straight, clear, free from such defects as would impair the value of clear lumber.

No. 2.—Logs not less than 14 inches in diameter and not over 24 feet, or not less than 12 inches in diameter and over 24 feet long, sound, reasonably straight, free from rotten knots or bunch-knots, and the grain straight enough to ensure strength.

No.. 3.—Logs having visible defects, such as bad crooks, bad knots, or other defects that would lower the grade of lumber below merchantable.

Culls.—Logs lower in grade than No. 3 will be classed as culls.

Diameter measurements, wherever referred to in this Schedule, shall be taken at the small end of the log.

BRITISH COLUMBIA LOG TABLE

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	11	12	13	14	15	16	17	18	19	20
10	43	52	63	74	87	100	114	130	146	163
12	52	63	76	89	104	120	137	156	175	195
14	60	73	88	104	121	140	160	181	204	228
16	69	84	101	119	139	160	183	207	233	261
18	77	94	113	134	156	180	206	233	262	293
20	86	105	126	149	174	200	229	259	292	326
22	95	115	138	164	191	220	252	285	321	358
24	103	126	151	178	208	240	274	311	350	391
26	112	136	164	193	226	260	297	337	379	424
28	120	147	176	208	243	280	320	363	408	456
30	129	157	189	223	260	300	343	389	437	489
32	137	168	201	238	278	320	366	415	466	521
34	146	178	214	253	295	340	389	441	496	554
36	155	189	227	268	312	360	412	467	525	586
38	163	199	239	283	330	380	435	492	554	619
40	172	210	252	297	347	400	457	518	583	652

Length in Ft.	Diameter in Inches									
	21	22	23	24	25	26	27	28	29	30
10	181	200	220	241	263	286	310	334	360	387
12	217	240	264	289	315	343	371	401	432	464
14	253	280	308	337	368	400	433	468	504	541
16	290	320	352	386	421	457	495	535	576	619
18	326	360	396	434	473	514	557	602	648	696
20	362	400	440	482	526	571	619	669	720	773
22	398	440	484	530	578	629	681	735	792	851
24	434	480	528	578	631	686	743	802	864	928
26	471	520	572	626	683	743	805	869	936	1005
28	507	560	616	675	736	800	867	936	1008	1083
30	543	600	660	723	789	857	929	1003	1080	1160
32	579	640	704	771	841	914	990	1070	1152	1237
34	615	680	748	819	894	971	1052	1137	1224	1315
36	652	720	792	868	946	1029	1114	1203	1296	1392
38	688	760	836	916	999	1086	1176	1270	1368	1469
40	724	800	880	964	1051	1143	1238	1337	1440	1547

BRITISH COLUMBIA LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length in Ft.	Diameter in Inches									
	31	32	33	34	35	36	37	38	39	40
10	414	443	472	503	534	567	600	634	669	706
12	497	531	567	603	641	680	720	761	803	847
14	580	620	661	704	748	793	840	888	937	988
16	663	708	756	804	855	906	960	1015	1071	1129
18	746	797	850	905	962	1020	1080	1141	1205	1270
20	828	886	945	1005	1068	1133	1200	1268	1340	1411
22	911	974	1039	1106	1175	1246	1320	1395	1473	1552
24	994	1063	1134	1207	1282	1360	1440	1522	1606	1693
26	1077	1151	1228	1307	1389	1473	1560	1649	1740	1834
28	1160	1240	1322	1408	1496	1586	1680	1776	1874	1976
30	1243	1328	1417	1508	1603	1700	1800	1902	2008	2117
32	1326	1417	1511	1609	1709	1813	1920	2030	2142	2258
34	1408	1506	1606	1709	1816	1926	2040	2156	2276	2399
36	1491	1594	1700	1810	1923	2040	2160	2283	2410	2540
38	1574	1683	1795	1911	2030	2153	2280	2410	2544	2681
40	1657	1771	1889	2011	2137	2266	2400	2537	2677	2822

Length in Ft.	Diameter in Inches									
	41	42	43	44	45	46	47	48	49	50
10	743	781	820	860	901	943	985	1029	1074	1120
12	891	937	984	1031	1081	1131	1183	1235	1289	1344
14	1040	1094	1148	1203	1261	1320	1380	1441	1504	1568
16	1188	1249	1312	1375	1441	1508	1577	1647	1718	1791
18	1337	1405	1476	1547	1621	1697	1774	1853	1933	2015
20	1485	1562	1640	1719	1801	1885	1971	2058	2148	2239
22	1634	1718	1804	1891	1982	2074	2168	2264	2363	2463
24	1782	1874	1967	2063	2162	2262	2365	2470	2578	2687
26	1931	2030	2131	2235	2342	2451	2562	2676	2792	2911
28	2080	2186	2295	2407	2522	2639	2759	2882	3007	3135
30	2228	2342	2459	2579	2702	2828	2956	3088	3222	3359
32	2377	2498	2623	2751	2882	3016	3153	3294	3437	3583
34	2525	2655	2787	2923	3062	3205	3350	3499	3652	3807
36	2674	2811	2951	3094	3242	3393	3548	3705	3866	4031
38	2822	2967	3115	3266	3423	3582	3745	3911	4081	4255
40	2971	3123	3279	3438	3603	3770	3942	4117	4296	4479

BRITISH COLUMBIA LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length in Ft.	Diameter in Inches									
	51	52	53	54	55	56	57	58	59	60
10	1166	1214	1262	1312	1360	1414	1466	1520	1574	1629
12	1400	1457	1515	1574	1632	1697	1759	1823	1889	1955
14	1633	1699	1767	1837	1904	1979	2053	2127	2203	2281
16	1866	1942	2020	2099	2176	2262	2346	2431	2518	2606
18	2099	2185	2272	2362	2448	2545	2639	2735	2833	2932
20	2333	2428	2525	2624	2721	2828	2932	3039	3148	3258
22	2565	2671	2777	2886	2993	3110	3226	3343	3462	3584
24	2799	2913	3030	3149	3265	3393	3519	3647	3777	3910
26	3032	3156	3282	3411	3537	3676	3812	3951	4092	4235
28	3266	3399	3535	3674	3809	3959	4105	4255	4407	4561
30	3499	3642	3787	3936	4081	4242	4399	4559	4721	4887
32	3732	3885	4040	4198	4353	4524	4692	4862	5036	5213
34	3965	4127	4292	4461	4625	4807	4985	5166	5351	5536
36	4199	4370	4545	4723	4897	5090	5278	5470	5666	5864
38	4432	4613	4797	4986	5169	5373	5572	5774	5980	6190
40	4665	4856	5050	5248	5441	5655	5865	6078	6295	6516

Length In Ft.	Diameter in Inches									
	61	62	63	64	65	66	67	68	69	70
10	1685	1745	1800	1859	1919	1980	2042	2105	2169	2233
12	2022	2094	2160	2231	2303	2376	2451	2526	2603	2679
14	2359	2443	2520	2603	2687	2772	2859	2947	3036	3126
16	2696	2791	2881	2975	3071	3168	3267	3368	3470	3672
18	3033	3140	3241	3347	3455	3565	3676	3789	3904	4019
20	3370	3489	3601	3719	3839	3961	4084	4210	4338	4465
22	3707	3838	3961	4091	4223	4357	4493	4631	4771	4912
24	4044	4187	4321	4463	4606	4753	4901	5052	5205	5358
26	4381	4536	4681	4834	4990	5149	5310	5473	5639	5805
28	4718	4885	5041	5206	5374	5545	5718	5894	6073	6251
30	5055	5234	5401	5578	5758	5941	6126	6315	6506	6698
32	5393	5583	5761	5950	6142	6337	6535	6736	6940	7144
34	5730	5932	6121	6322	6526	6733	6943	7157	7374	7591
36	6067	6281	6481	6694	6910	7129	7352	7578	7808	8037
38	6404	6630	6841	7066	7293	7525	7760	7999	8241	8484
40	6741	6979	7201	7437	7677	7921	8169	8420	8675	8930

SCRIBNER LOG TABLE

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches								
	12	13	14	15	16	17	18	19	20
20	98	122	143	178	198	232	267	300	350
22	108	134	157	196	218	255	294	330	385
24	118	146	172	214	238	278	320	360	420
26	127	159	186	231	257	302	347	390	455
28	137	171	200	249	277	325	374	420	490
30	147	183	214	267	297	348	400	450	525
32	157	195	229	285	317	371	427	480	560
34	167	207	243	303	337	394	454	510	595
36	176	220	257	320	356	418	481	540	630
38	186	232	272	338	376	441	507	570	665
40	196	244	286	356	396	464	534	600	700
42	206	256	300	374	416	487	561	630	735
44	216	268	315	392	436	510	587	660	770
46	225	281	329	409	455	534	614	690	805
48	235	293	343	427	475	557	641	720	840
50	245	305	357	445	495	580	667	750	875
52	255	317	372	463	515	603	694	780	910
54	265	329	386	481	535	626	721	810	945
56	274	342	400	498	554	650	748	840	980
58	284	354	405	516	574	673	774	870	1015
60	294	366	429	534	594	696	801	900	1050
62	304	378	443	552	614	719	828	930	1085
64	314	390	458	570	634	742	854	960	1120
66	323	403	472	587	653	766	881	990	1155
68	333	415	486	605	673	789	908	1020	1190
70	343	427	500	623	693	812	934	1050	1225

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	21	22	23	24	25	26	27	28	29	30
20	380	418	470	505	573	625	684	728	761	821
22	418	460	517	555	630	687	752	801	837	903
24	456	502	564	606	688	750	821	874	913	985
26	494	543	611	656	745	812	889	946	989	1067
28	532	587	658	707	802	875	958	1019	1065	1149
30	570	627	705	757	859	937	1026	1092	1141	1231
32	608	669	752	808	917	1000	1094	1165	1218	1314
34	646	711	799	858	974	1062	1162	1238	1294	1396
36	684	752	846	909	1031	1125	1231	1310	1370	1478
38	722	794	893	959	1089	1187	1300	1383	1446	1560
40	760	836	940	1010	1146	1250	1368	1456	1522	1642
42	798	878	987	1060	1203	1312	1436	1529	1598	1724
44	836	920	1034	1111	1261	1375	1505	1602	1674	1806
46	874	961	1081	1161	1318	1437	1572	1674	1750	1888
48	912	1003	1128	1212	1375	1500	1642	1747	1826	1970
50	950	1045	1175	1262	1432	1562	1710	1820	1902	2052
52	988	1087	1222	1313	1490	1625	1778	1893	1979	2135
54	1026	1129	1269	1363	1547	1687	1847	1966	2055	2217
56	1064	1170	1316	1414	1604	1750	1915	2038	2131	2299
58	1102	1212	1363	1464	1662	1812	1984	2111	2207	2381
60	1140	1254	1410	1515	1719	1875	2052	2184	2283	2463
62	1178	1296	1457	1565	1776	1937	2120	2257	2359	2545
64	1216	1338	1504	1616	1834	2000	2189	2330	2435	2627
66	1254	1379	1551	1666	1891	2062	2257	2402	2511	2709
68	1292	1421	1598	1717	1948	2125	2326	2475	2587	2791
70	1330	1463	1645	1767	2005	2187	2394	2548	2663	2873

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	31	32	33	34	35	36	37	38	39	40
20	888	920	980	1000	1095	1152	1287	1335	1400	1505
22	977	1012	1078	1100	1204	1267	1416	1468	1540	1655
24	1066	1104	1176	1200	1314	1382	1544	1602	1680	1806
26	1154	1196	1274	1300	1423	1498	1673	1735	1820	1956
28	1243	1288	1372	1400	1533	1613	1802	1869	1960	2107
30	1332	1380	1470	1500	1642	1728	1930	2002	2100	2257
32	1421	1472	1568	1600	1752	1843	2059	2136	2240	2408
34	1510	1564	1666	1700	1861	1958	2188	2269	2380	2558
36	1598	1656	1764	1800	1971	2074	2317	2403	2520	2709
38	1687	1748	1862	1900	2080	2189	2445	2536	2660	2859
40	1776	1840	1960	2000	2190	2304	2574	2670	2800	3010
42	1865	1932	2058	2100	2299	2419	2703	2803	2940	3160
44	1954	2024	2156	2200	2409	2534	2831	2937	3080	3311
46	2042	2116	2254	2300	2518	2650	2960	3070	3220	3461
48	2131	2208	2352	2400	2628	2765	3089	3204	3360	3612
50	2220	2300	2450	2500	2737	2880	3217	3337	3500	3762
52	2309	2392	2548	2600	2847	2995	3346	3471	3640	3913
54	2398	2484	2646	2700	2956	3110	3475	3604	3780	4063
56	2486	2576	2744	2800	3066	3226	3604	3738	3920	4214
58	2575	2668	2842	2900	3175	3341	3732	3871	4060	4364
60	2664	2760	2940	3000	3285	3456	3861	4005	4200	4515
62	2753	2852	3038	3100	3394	3571	3990	4138	4340	4665
64	2842	2944	3136	3200	3504	3686	4118	4272	4480	4816
66	2930	3036	3234	3300	3613	3802	4247	4405	4620	4966
68	3019	3128	3332	3400	3723	3917	4376	4538	4760	5117
70	3108	3220	3430	3500	3832	4032	4504	4672	4900	5267

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	41	42	43	44	45	46	47	48	49	50
20	1590	1679	1745	1850	1898	1983	2070	2160	2246	2340
22	1749	1847	1919	2035	2088	2181	2277	2376	2471	2574
24	1908	2015	2094	2220	2278	2380	2484	2592	2695	2808
26	2067	2183	2268	2405	2467	2578	2691	2808	2920	3042
28	2226	2351	2443	2590	2657	2776	2898	3024	3124	3276
30	2385	2518	2617	2775	2847	2974	3105	3240	3369	3510
32	2544	2686	2792	2960	3037	3173	3312	3456	3594	3744
34	2703	2854	2966	3145	3227	3371	3519	3672	3818	3978
36	2862	3022	3141	3330	3416	3569	3726	3888	4043	4212
38	3021	3190	3315	3515	3606	3768	3933	4104	4267	4446
40	3180	3358	3490	3700	3796	3966	4140	4320	4492	4680
42	3339	3526	3664	3885	3986	4164	4347	4536	4717	4914
44	3498	3694	3839	4070	4176	4363	4554	4752	4941	5148
46	3657	3862	4013	4255	4365	4561	4761	4968	5166	5382
48	3816	4030	4188	4440	4555	4759	4968	5184	5390	5616
50	3975	4197	4362	4625	4745	4957	5175	5400	5615	5850

Length In Ft.	Diameter in Inches									
	51	52	53	54	55	56	57	58	59	60
20	2434	2530	2630	2730	2832	2938	3044	3154	3266	3380
22	2677	2783	2893	3003	3115	3232	3348	3469	3593	3718
24	2921	3036	3156	3276	3398	3526	3653	3785	3919	4056
26	3164	3289	3419	3549	3682	3819	3957	4100	4246	4394
28	3408	3542	3682	3822	3965	4113	4262	4416	4572	4732
30	3651	3795	3945	4095	4248	4407	4566	4731	4899	5070
32	3894	4048	4208	4368	4531	4701	4870	5046	5226	5408
34	4138	4301	4471	4641	4814	4995	5175	5262	5552	5746
36	4381	4554	4734	4914	5098	5288	5479	5677	5879	6084
38	4625	4807	4997	5187	5381	5582	5784	5993	6205	6422
40	4868	5060	5260	5460	5664	5876	6088	6308	6532	6760
42	5111	5313	5523	5733	5947	6170	6392	6623	6859	7098
44	5355	5566	5786	6006	6230	6464	6697	6939	7185	7436
46	5598	5819	6049	6279	6514	6757	7001	7254	7512	7774
48	5842	6072	6312	6552	6797	7051	7306	7570	7838	8112
50	6085	6325	6575	6825	7080	7345	7610	7885	8165	8450

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	61	62	63	64	65	66	67	68	69	70
20	3496	3614	3734	3858	3982	4110	4240	4374	4510	4648
22	3846	3975	4107	4244	4380	4521	4664	4811	4961	5113
24	4195	4337	4481	4630	4778	4932	5088	5249	5412	5578
26	4545	4698	4854	5015	5177	5343	5512	5686	5863	6042
28	4894	5060	5223	5401	5575	5754	5936	6124	6314	6507
30	5244	5421	5601	5787	5973	6165	6360	6561	6765	6972
32	5594	5782	5974	6173	6371	6576	6784	6998	7216	7437
34	5943	6144	6348	6559	6769	6987	7208	7436	7667	7902
36	6293	6505	6721	6944	7168	7398	7632	7873	8118	8366
38	6642	6867	7095	7330	7566	7809	8056	8311	8569	8831
40	6992	7228	7468	7716	7964	8220	8480	8748	9020	9296
42	7342	7589	7841	8102	8362	8631	8904	9185	9471	9761
44	7691	7951	8215	8488	8760	9042	9328	9622	9922	10226
46	8041	8312	8588	8874	9158	9453	9752	10060	10373	10791
48	8390	8674	8962	9260	9556	9864	10176	10498	10824	11156
50	8740	9035	9335	9645	9955	10275	10600	10935	11275	11620

THE SCRIBNER RULE

This is the oldest log scale now in general use. It was originally published in Scribner's Lumber and Log Book, in later editions of which it was replaced by the Doyle Rule. It is now usually called the "Old Scribner Rule," and is used to some extent in nearly every state. The rule was based on computations derived from diagrams drawn to show the number of inch boards that can be sawed from logs of different sizes after allowing for waste. The contents of these boards was then calculated and the table built up in this way. Sometimes the Scribner Rule is converted into what is known as the Scribner Decimal Rule by dropping the units and rounding the values to the nearest tens. Thus 107 board feet would be written 11 in the Decimal Rule; 104 would be written 10. The Hyslop Rule is practically the same as the Scribner Decimal Rule. The Scribner Rule is known in Minnesota as the Minnesota Standard Rule. In the original table no values were given below a diameter of 12 inches.

In the judgment of most sawyers, the Scribner Rule gives very fair results for small logs cut by circular saws (about 8 gauge), but that for larger logs, about 28 inches, for example, the results are too small. It often happens that defects are greater in large logs than in small ones, because the larger are from older trees, which are more likely to be overmature. Even with these, however, the Scribner Rule is fairly satisfactory if the scaler does not make a further deduction for defects. As a matter of fact, a log rule should make no allowance for defect, because that is unfair to high-grade sound logs; only the scaler should make such allowance. In sound logs the saw cut has been known to overrun the Scribner scale from 10 to 20 per cent.

The Forest Service of the United States Department of Agriculture has adopted the Scribner Decimal Rule for timber sales on the National Forests. It has been in use for about four years and, in the main, has proved satisfactory, since competitive bids enable the buyer to bid higher if the character of the logs indicates a mill overrun.

SPAULDING LOG TABLE

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches								
	12	13	14	15	16	17	18	19	20
16	77	94	114	137	161	188	216	245	276
18	87	106	129	154	181	211	243	276	310
20	96	118	143	171	201	235	270	306	345
22	106	130	157	188	221	258	297	337	379
24	116	142	172	206	242	282	324	368	414
26	125	153	186	223	262	304	360	398	448
28	134	164	200	240	282	328	378	423	482
30	144	176	214	257	302	352	404	460	516
32	154	188	228	274	322	376	432	490	552
34	164	200	243	291	342	398	458	520	586
36	174	212	258	308	362	422	486	552	620
38	183	224	272	325	382	446	512	582	654
40	192	236	286	342	402	470	540	612	690
42	202	248	300	359	422	492	566	644	724
44	212	260	314	376	442	516	596	674	758
46	222	272	329	394	463	540	620	704	792
48	232	284	344	412	484	564	648	734	828
50	241	295	358	429	503	587	674	766	861
52	250	306	372	446	524	608	720	796	896
54	259	317	386	463	544	632	728	826	930
56	268	328	400	480	564	656	764	858	964
58	278	340	414	497	584	680	782	888	998
60	288	352	428	514	604	706	808	920	1032

SPAULDING LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	21	22	23	24	25	26	27	28	29	30
16	308	341	376	412	449	488	528	569	612	656
18	346	384	423	463	505	549	594	640	688	738
20	385	426	470	515	561	610	660	711	765	820
22	423	469	517	566	617	671	726	782	841	902
24	462	512	564	618	674	732	792	854	918	984
26	500	554	611	668	730	792	858	924	994	1066
28	538	596	658	720	786	854	924	996	1070	1148
30	576	640	704	774	842	915	990	1066	1146	1230
32	616	682	752	824	898	976	1056	1138	1224	1312
34	654	724	798	874	954	1036	1122	1208	1300	1394
36	692	768	846	926	1010	1098	1188	1280	1376	1476
38	730	810	892	978	1066	1158	1254	1352	1452	1558
40	770	852	940	1030	1122	1220	1320	1422	1530	1640
42	808	896	986	1080	1178	1281	1386	1493	1606	1722
44	846	938	1034	1134	1234	1342	1452	1565	1682	1804
46	884	980	1080	1184	1290	1402	1518	1636	1758	1886
48	924	1024	1128	1236	1348	1464	1584	1708	1836	1968
50	961	1066	1174	1289	1404	1524	1650	1778	1911	2050
52	1000	1108	1220	1338	1460	1584	1716	1848	1988	2132
54	1038	1151	1268	1390	1516	1646	1782	1920	2064	2214
56	1076	1192	1316	1440	1572	1706	1838	1992	2140	....
58	1114	1236	1362	1494	1628	1768	1914	2062	2226	....
60	1152	1280	1408	1548	1684	1830	1980	2132	2292	....

SPAULDING LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	31	32	33	34	35	36	37	38	39	40
16	701	748	796	845	897	950	1006	1064	1124	1185
18	789	841	895	951	1009	1069	1132	1197	1264	1333
20	876	935	995	1056	1121	1188	1258	1330	1405	1481
22	964	1028	1094	1162	1233	1307	1384	1463	1545	1629
24	1052	1122	1194	1268	1346	1426	1510	1596	1686	1778
26	1139	1214	1292	1372	1458	1544	1634	1728	1826	1926
28	1226	1308	1392	1478	1570	1662	1760	1862	1966	2074
30	1314	1402	1492	1584	1682	1782	1886	1994	2106	2222
32	1402	1496	1592	1690	1794	1900	2012	2128	2248	2370
34	1490	1588	1690	1796	1906	2020	2138	2261	2388	2518
36	1578	1682	1790	1902	2018	2138	2264	2394	2528	2666
38	1664	1776	1890	2006	2130	2256	2390	2526	2668	2814
40	1752	1870	1990	2112	2242	2376	2516	2660	2810	2962
42	1840	1963	2089	2218	2354	2495	2642	2793	2950	3110
44	1928	2056	2188	2324	2466	2614	2768	2926	3090	3258
46	2016	2150	2288	2430	2579	2732	2894	3059	3230	3407
48	2104	2244	2388	2536	2692	2852	3020	3192	3372	3556
50	2190	2337	2486	2640	2804	2970	3144	3324	3512	3704

Length In Ft.	Diameter in Inches									
	41	42	43	44	45	46	47	48	49	50
16	1248	1312	1377	1448	1512	1581	1652	1724	1797	1872
18	1404	1476	1549	1629	1701	1779	1858	1939	2022	2106
20	1560	1640	1721	1810	1890	1976	2065	2155	2246	2340
22	1716	1804	1893	1991	2079	2174	2271	2370	2470	2574
24	1872	1968	2066	2172	2268	2372	2478	2586	2696	2808
26	2028	2132	2238	2352	2456	2568	2684	2800	2920	3044
28	2184	2296	2410	2534	2646	2766	2890	3016	3144	3276
30	2340	2460	2582	2714	2834	2964	3096	3232	3370	3510
32	2496	2624	2754	2896	3024	3162	3304	3448	3594	3744
34	2652	2788	2926	3076	3212	3360	3510	3663	3819	3978
36	2808	2952	3098	3258	3402	3558	3716	3879	4043	4212
38	2964	3116	3270	3439	3590	3755	3923	4094	4268	4446
40	3120	3280	3442	3620	3780	3952	4130	4310	4492	4680

SPAULDING LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

Length In Ft.	Diameter in Inches									
	51	52	53	54	55	56	57	58	59	60
16	1948	2025	2104	2184	2266	2350	2436	2524	2613	2704
18	2191	2278	2367	2457	2550	2644	2740	2839	2940	3042
20	2435	2531	2630	2730	2833	2938	3045	3155	3266	3380
22	2678	2784	2893	3003	3116	3232	3349	3470	3592	3718
24	2922	3038	3156	3276	3400	3526	3654	3786	3920	4056
26	3164	3290	3418	3548	3682	3818	3958	4100	4246	4394
28	3408	3544	3682	3822	3966	4112	4262	4416	4572	4732
30	3652	3796	3944	4094	4250	4406	4566	4732	4900	5070
32	3896	4050	4203	4368	4532	4700	4872	5048	5226	5408

SCALING AND GRADING RULES OF THE COLUMBIA RIVER LOG SCALING AND GRADING BUREAU

No. 1 Logs shall be 30 inches and over in diameter inside the bark at the small end and not less than 16 or more than 40 feet in length, and shall, in the judgment of the scaler, be practically suitable for the manufacture of upper grades of lumber.

No. 2 Logs shall be 16 inches and over in diameter inside the bark at the small end and not less than 16 or more than 40 feet in length, and shall, in the judgment of the scaler, be practically suitable for the manufacture of merchantible lumber.

No. 3 Logs shall be 12 inches and over in diameter inside the bark at the small end and not less than 16 or more than 40 feet in length, and shall, in the judgment of the scaler, be practically suitable for the manufacture of inferior grades of lumber.

Cull Logs shall be any logs which in the judgment of the scaler are not practically suitable for manufacture.

All logs to be scaled by the Spaulding Rule.

THE SPAULDING RULE

The Spaulding is the statute rule of California, adopted by an act of the legislature in 1878. It is used also in Oregon, Washington, Utah, and Nevada. It was computed from carefully drawn diagrams of logs from 10 to 96 inches in diameter at the small end. Mill men seem to be well satisfied with its results. It is very similar to the Scribner Rule.

THE INTERNATIONAL METRIC SYSTEM

SYNOPSIS OF THE SYSTEM

The fundamental unit of the metric system is the Meter—the unit of length. From this the units of capacity (Liter) and of weight (Gram) were derived. All other units are the decimal sub-divisions or multiples of these. These three units are simply related; e. g., for all practical purposes one Cubic Decimeter equals one Liter and one Liter of water weighs one Kilogram. The metric tables are formed by combining the words "Meter," "Gram," and "Liter" with the six numerical prefixes, as in the following tables:

PREFIXES	MEANING			UNITS
milli-	= one thousandth	1/1000	.001	
centi-	= one hundredth	1/100	.01	**"meter"** for length
deci-	= one tenth	1/10	.1	
Unit	= one		1	**"gram" for weight or mass**
deka-	= ten	10/1	10	
hecto-	= one hundred	100/1	100	**"liter"** for capacity
kilo-	= one thousand	1000/1	1000	

UNITS OF LENGTH

milli-meter	=	**.001**	**meter**
centi-meter	=	**.01**	**meter**
deci-meter	=	**.1**	**meter**
METER	=	**1**	**meter**
deka-meter	=	**10**	**meter**
hecto-meter	=	**100**	**meter**
kilo-meter	=	**1000**	**meter**

Where miles are used in England and the United States for measuring distances, the kilometer (1,000 meters) is used in metric countries. The kilometer is about 5 furlongs. There are about 1,600 meters in a statute mile, 20 meters in a chain, and 5 meters in a rod.

The meter is used for dry goods, merchandise, engineering construction, building, and other purposes where the yard and foot are used. The meter is about a tenth longer than the yard.

The centimeter and millimeter are used instead of the inch and its fractions in machine construction and similar work. The centimeter, as its name shows, is the hundredth of a meter. It is used in cabinet work, in expressing sizes of paper, books, and many cases where the inch is used. The centimeter is about two-fifths of an inch and the millimeter about one twenty-fifth of an inch. The millimeter is divided for finer work into tenths, hundredths, and thousandths.

If a number of distances in millimeters, meters, and kilometers are to be added, reduction is unnecessary. They are added as dollars, dimes, and cents are now added. For example, "1,050.25 meters" is not read "1 kilometer, 5 dekameters, 2 decimeters, and 5 centimeters," but "one thousand and fifty meters, twenty-five centimeters," just as "$1,050.25" is read "one thousand and fifty dollars and twenty-five cents."

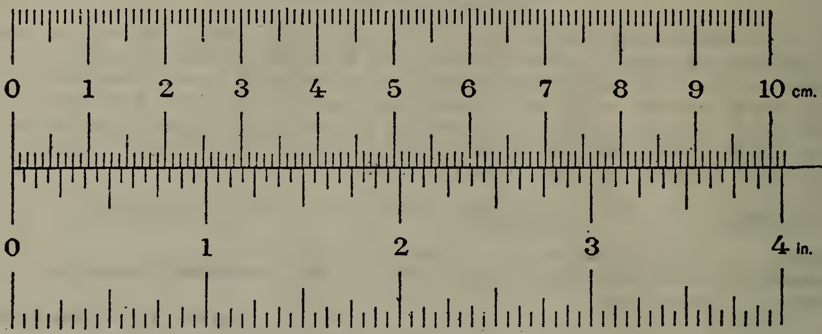


FIG. 1. COMPARISON SCALE: 10 CENTIMETERS AND 4 INCHES. (ACTUAL SIZE.)

AREA

The table of areas is formed by squaring the length measures, as in our common system. For land measure 10 meters square is called an "Are" (meaning "area".) The side of one are is about 33 feet. The Hectare is 100 meters square, and, as its name indicates, is 100 areas, or about 2½ acres. An acre is about 0.4 hectare. A standard United States quarter section contains almost exactly 64 hectares. A square kilometer contains 100 hectares.

For smaller measures of surface the square meter is used. The square meter is about 20 per cent larger than the square yard. For still smaller surfaces the square centimeter is used. A square inch contains about 6½ square centimeters.

VOLUME

The cubic measures are the cubes of the linear units. The cubic meter (sometimes called the stere, meaning "solid") is the unit of volume. A cubic meter of water weighs a metric ton and is equal to 1 kiloliter. The cubic meter is used in place of the cubic yard and is about 30 per cent larger. This is used for "cuts and fills" in grading land, measuring timber, expressing contents of tanks and reservoirs, flow of rivers, dimensions of stone, tonnage of ships, and other places where the cubic yard and foot are used. The thousandth part of the cubic meter (1 cubic decimeter) is called the Liter.

For very small volumes the cubic centimeter (cc or cm3) is used. This volume of water weighs a gram, which is the unit of weight or mass. There are about 16 cubic centimeters in a cubic inch. The cubic centimeter is the unit of volume used by chemists as well as in pharmacy, medicine, surgery, and other technical work. One thousand cubic centimeters make 1 liter.

UNITS OF CAPACITY

milli-liter	=	.001	liter
centi-liter	=	.01	liter
deci-liter	=	.1	liter
LITER	=	1	liter
deka-liter	=	10	liter
hecto-liter	=	100	liter
kilo-liter	=	1000	liter

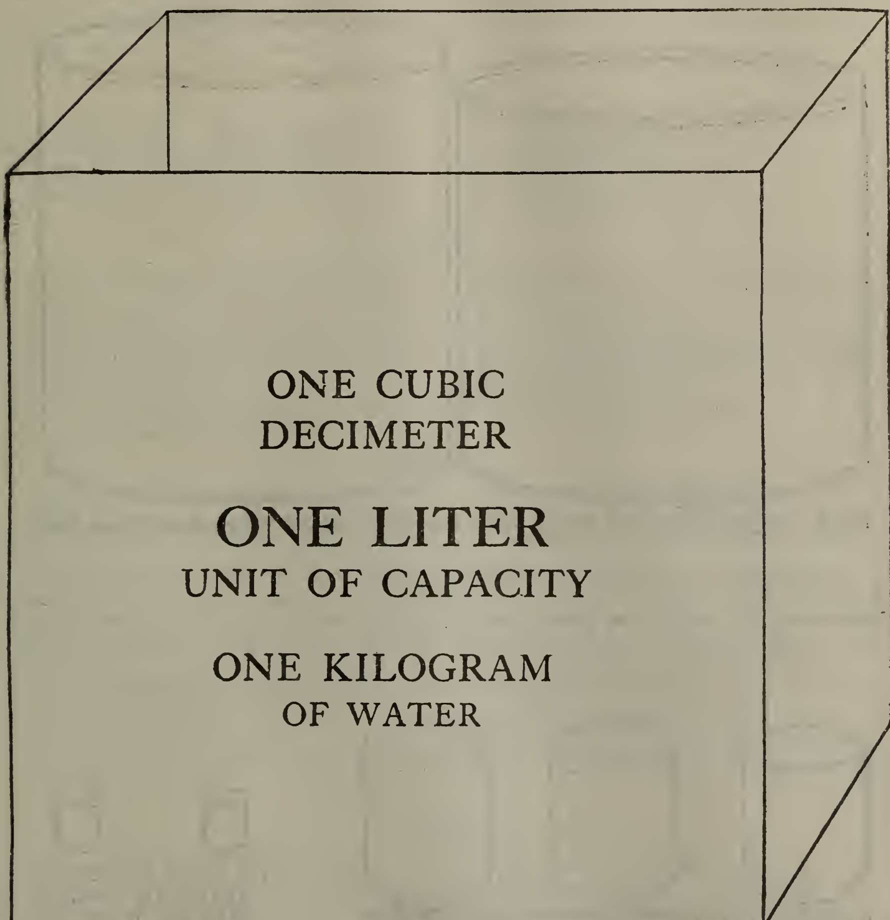


FIG. 2. CUBIC DECIMETER. (ACTUAL SIZE.)

The hectoliter (100 liters) serves the same purposes as the United States bushel (2,150.42 cubic inches), and is equal to about 3 bushels, or a barrel. A peck is about 9 liters. The liter is used for measurements commonly given in the gallon, the liquid and dry quarts, a liter being 5 per cent larger than our liquid quart and 10 per cent smaller than the dry quart. A liter of water weighs exactly a kilogram, i. e., 1,000 grams. A thousand liters of water weigh 1 metric ton.

UNITS OF WEIGHT (OR MASS)

milli-gram	=	0.001	gram
centi-gram	=	.01	gram
deci-gram	=	.1	gram
GRAM	=	1	gram
deka-gram	=	10	gram
hecto-gram	=	100	gram
kilo-gram	=	1000	gram

FIG. 3. RELATIVE SIZE OF 2-POUND AND 1-KILOGRAM (BRASS) WEIGHTS. (ACTUAL SIZE.)

Measurements commonly expressed in gross tons or short tons are stated in metric tons (1,000 kilograms). The metric ton comes between our long and short tons and serves the purpose of both. The kilogram and "half kilo" serve for everyday trade, the latter being 10 per cent larger than the pound. The

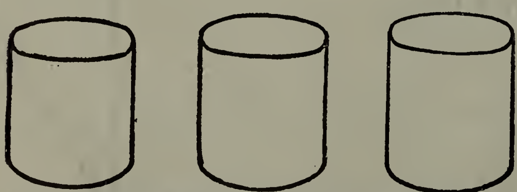


FIG. 4. RELATIVE SIZE OF AVOIRDUPOIS OUNCE, 30-GRAM, AND TROY OUNCE (BRASS) WEIGHTS. (ACTUAL SIZE.)

FIG. 5. RELATIVE SIZE OF GRAM AND SCRUPLE (BRASS) WEIGHTS. (ACTUAL SIZE.)

kilogram is approximately 2.2 pounds. The gram and its multiples and divisions are used for the same purposes as ounces, pennyweights, drams, scruples, and grains. For foreign postage, 30 grams is the legal equivalent of the avoirdupois ounce.

EQUIVALENTS OF METRIC WEIGHTS AND MEASURES

In the metric system multiples of the units are expressed by the use of the Greek prefix deca, hecto, and kilo, which indicates, respectively, tens, hundreds, and thousands; decimal parts of the unit are expressed by use of the Latin prefix deci, centi, and milli, which indicates, respectively, tenth, hundredth, and thousandth. For all practical purposes 1 cubic decimeter equals 1 liter, and 1 liter of water weighs 1 kilogram or 1 kilo, as it is generally abbreviated. In the tables following are comparisons of the customary and metric units.

LENGTHS

1 millimeter (mm.) equals 0.03937 inch.
1 centimeter (cm.) equals 0.3937 inch.
1 meter (m) equals 3.28083 feet.
1 meter equals 1.093611 yards.
1 kilometer (km.) equals 0.62137 mile.

1 inch equals 25.4001 millimeters.
1 inch equals 2.54001 centimeters.
1 foot equals 0.304801 meter.
1 yard equals 0.914402 meter.
1 mile equals 1.60935 kilometers.

AREAS

1 square millimeter equals 0.00155 square inch.
1 square centimeter equals 0.155 square inch.
1 square meter equals 10.764 square feet.
1 square meter equals 1.196 square yards.
1 square kilometer equals 0.3861 square mile.
1 hectare equals 2.471 acres.

1 square inch equals 645.16 square millimeters.
1 square inch equals 6.452 square centimeters.
1 square foot equals 0.0929 square meter.
1 square yard equals 0.8361 square meter.
1 square mile equals 2.59 square kilometers.
1 acre equals 0.4047 hectare.

VOLUMES

1 cubic centimeter equals 0.061 cubic inch.
1 cubic meter equals 35.314 cubic feet.
1 cubic meter equals 1.3079 cubic yards.

1 cubic inch equals 16.3872 cubic centimeters.
1 cubic foot equals 0.02832 cubic meter.
1 cubic yard equals 0.7645 cubic meter.

CAPACITIES

1 milliliter (cc.) equals 0.03381 liquid ounce.
1 milliliter (cc.) equals 0.2705 dram.
1 milliliter (cc.) equals 0.8115 scruple.
1 liter equals 1.05668 liquid quarts.
1 liter equals 0.26417 gallon.
1 liter equals 0.9081 dry quart.
1 liter equals 0.11351 peck.
1 dekaliter equals 1.1381 pecks.
1 hectoliter (hl.) equals 2.83774 bushels.

1 liquid ounce equals 29.574 milliliters.
1 dram equals 3.6967 milliliters.
1 scruple equals 1.2322 milliliters.
1 liquid quart equals 0.94636 liter.
1 gallon equals 3.78543 liters.
1 dry quart equals 1.1012 liters.
1 peck equals 8.80982 liters.
1 peck equals 0.881 dekaliter.
1 bushel equals 0.35239 hectoliter.

MASSES

1 gram equals 15.4324 grains.
1 gram equals 0.03527 avoir. ounce.
1 gram equals 0.03215 troy ounce.
1 kilogram (kg.) equals 2.20462 avoir. pounds.
1 kilogram equals 2.67923 troy pounds.

1 grain equals 0.0648 gram.
1 avoir. ounce equals 28.3495 grams.
1 troy ounce equals 31.10348 grams.
1 avoir. pound equals 0.45359 kilogram.
1 troy pound equals 0.37324 kilogram.

Note: The unit of lumber measure is called the "Stere" and is equal to the cubic meter.

COMPARISON OF THE VARIOUS POUNDS AND TONS IN USE IN THE UNITED STATES

1 Troy Pound Equals

0.822857	Avoirdupois Pounds.
0.37324	Kilograms.
0.00041143	Short Tons.
0.00036735	Long Tons.
0.00037324	Metric Tons.

1 Avoirdupois Pound Equals

1.21528	Troy Pounds.
0.45359	Kilograms.
0.0005	Short Tons.
0.00044643	Long Tons.
0.00045359	Metric Tons.

1 Kilogram Equals

2.67923	Troy Pounds.
2.20462	Avoirdupois Pounds.
0.00110231	Short Tons.
0.00098421	Long Tons.
0.001	Metric Tons.

1 Short Ton Equals

2430.56	Troy Pounds.
2000	Avoirdupois Pounds.
907.18	Kilograms.
0.89287	Long Tons.
0.90718	Metric Tons.

1 Long Ton Equals

2722.22	Troy Pounds.
2240	Avoirdupois Pounds.
1016.05	Kilograms.
1.12	Short Tons.
1.01605	Metric Tons.

1 Metric Ton Equals

2679.23	Troy Pounds.
2204.62	Avoirdupois Pounds.
1000	Kilograms.
1.10231	Short Tons.
0.98421	Long Tons.

Note: A cubic meter of water weighs a metric ton and is equal to one kiloliter. The cubic meter is used in the place of the cubic yard and is about 30 per cent larger.

THE METRIC UNIT OF LUMBER MEASURE

The unit of lumber measure is called the **Stere**, and is equal to the cubic meter.

1 Stere (cubic meter) equals 35.314 Cubic Feet
1 Cubic foot equals 0.028317 Cubic Steres
1 Stere equals 0.2759 Cords
1 Cord (128 cubic feet) equals 3.624 Steres

The term Stere is from the Greek stereos, meaning solid.

WEIGHT

One Stere or cubic meter of Green Douglas Fir contains 423.7734 Board Feet and weighs approximately 1413 pounds or 636 kilograms.

1 Metric Ton equals 0.984206 Long Tons
1 Metric Ton equals 1.102311 Short Tons
1 Metric Ton equals 1000. Kilograms
1 Metric Ton equals 2204.62234 Pounds
1000 Board Feet Green Douglas Fir weighs 3333 Pounds
1000 Board Feet Green Douglas Fir weighs 1512 Kilograms

METHOD USED FOR COMPUTING APPROXIMATE WEIGHT OF FOREIGN EXPORT CARGO SHIPMENTS OF DOUGLAS FIR

1000 Board Feet weighs 1½ Long Tons
1000 Board Feet weighs 1½ Metric Tons
1 Board Foot weighs 1½ Kilograms

One St. Petersburg Standard of 165 cubic feet (1980 board feet) weighs 6593 **pounds or 2970 kilograms.**

HOW TO CUT METRIC LENGTHS

Orders from France and Belgium usually call for lengths of lumber to be cut to the metric foot, which represents the third part of a meter.

The required length is equivalent to 13⅛ inches. The thickness and width usually correspond to English measure.

French orders contain large amounts of 3x9 of number 1 and 2 Clear grade.

HOW TO FIGURE METRIC ORDERS

To convert Metric to English lengths, multiply by 35 and divide by 32, or to the Metric Feet add one-twelfth and one-eighth of one-twelfth.

How many feet, Board Measure, are contained in the following items of 3x9 cut to Metric Feet?

Process:

Pcs.	Size	Met. Ft.	Extensions	
60	3x9	12	720	
114	3x9	14	1,596	
112	3x9	16	1,792	
40	3x9	18	720	
60	3x9	20	1,200	
386			6,028	Metric Lineal Feet
			502.33	
			62.79	
			6,593.12	English Lineal Feet.
			2¼	
			13,186.24	
			1,648.28	
			14,834.52	Feet Board Measure.

The addition of the extensions shows the number of Metric Lineal Feet, the line below shows that amount divided by 12, and this in turn is divided by 8.

The total thus obtained shows the English Lineal Feet. This is brought to Board Measure in the usual way by multiplying by 2¼.

TO COMPUTE METRIC DRAFT

French and a number of foreign ships use the metric system, and the draft is painted on the forward and after end of vessel in meters and twentieth parts of a meter, as follows:

The height of figures and distance between figures is uniform, i. e.: each figure is one-tenth of a meter (3.937 inches) in height, and the blank distance between figures is also one-tenth of a meter.

Each advancing meter is indicated by the letter "M" to the right of the numeral.

For example: Presume the draft water line is at the bottom of 60, and the first figure representing the meters above the water line is 4 M, the draft would be 3.60 meters or 11.811 feet (11 ft. 9¾ in.). If the water line was level with the top of the figure 60, the draft would then be 3.70 meters or 12.139 feet (12 ft. 1¾ in.).

4M
80
60
40
20
3M
80
60
40
20
2M

TO CONVERT METRIC TO ENGLISH DRAFT

Rule:
To convert the metric draft to English feet, multiply the meters by 3.281.

Example:
Find the number of English Feet when the draft is 7.20 meters?

Operation:
7.20 × 3.281 equals 23.6232 feet (23 ft. 7½ in.) Multiplying the meters by 105 and dividing by 32 gives the same result.

TO CONVERT ENGLISH TO METRIC DRAFT

Rule:
To convert English to Metric draft, multiply the feet by 3.048.

Example:
Find the number of Meters, when the English draft in feet is 23 ft. 7½ inches (23.6232 feet).

Operation:
23.6232 × 3.048 equals 7.20035136 Meters.
The same result is obtained by multiplying the English Feet by 32 and dividing by 105.

Example:
Find the numbers of meters, where the English draft is 21 feet.

Operation:
21 multiplied by 32 equals 672; 672 divided by 105 equals 6.40 meters.

USEFUL TABLES FOR CONVERTING DRAFT EQUIVALENTS OF DECIMAL AND BINARY FRACTIONS OF AN INCH IN MILLIMETERS

Fractions of an Inch.		Millimeters.	Decimals of an Inch.
1/64	equals	0.397	0.015625
1/32	equals	.794	.03125
1/16	equals	1.588	.0625
1/8	equals	3.175	.1250
1/4	equals	6.350	.2500
1/2	equals	12.700	.5
1/100	equals	0.254	

Inches to Millimeters

1	equals	25.4001
2	equals	50.8001
3	equals	76.2002
4	equals	101.6002
5	equals	127.0003
6	equals	152.4003
7	equals	177.8004
8	equals	203.2004
9	equals	228.6005
10	equals	254.0006
11	equals	279.4006
12	equals	304.8006

Millimeters to Inches

1	equals	0.03937
2	equals	0.07874
3	equals	0.11811
4	equals	0.15748
5	equals	0.19685
6	equals	0.23622
7	equals	0.27559
8	equals	0.31496
9	equals	0.35433
10	equals	0.39370
11	equals	0.43307
12	equals	0.47244

CONVERSION TABLES

CONVERSION OF FEET TO METERS

Feet	Meters	Feet	Meters
1	0.30480	51	15.54483
2	.60960	52	15.84963
3	.91440	53	16.15443
4	1.21920	54	16.45923
5	1.52400	55	16.76403
6	1.82880	56	17.06883
7	2.13360	57	17.37363
8	2.43840	58	17.67844
9	2.74321	59	17.98324
10	3.04801	60	18.28804
11	3.35281	61	18.59284
12	3.65761	62	18.89764
13	3.96241	63	19.20244
14	4.26721	64	19.50724
15	4.57201	65	19.81204
16	4.87681	66	20.11684
17	5.18161	67	20.42164
18	5.48641	68	20.72644
19	5.79121	69	21.03124
20	6.09601	70	21.33604
21	6.40081	71	21.64084
22	6.70561	72	21.94564
23	7.01041	73	22.25044
24	7.31521	74	22.55525
25	7.62002	75	22.86005
26	7.92482	76	23.16485
27	8.22962	77	23.46965
28	8.53442	78	23.77445
29	8.83922	79	24.07925
30	9.14402	80	24.38405
31	9.44882	81	24.68885
32	9.75362	82	24.99365
33	10.05842	83	25.29845
34	10.36322	84	25.60325
35	10.66802	85	25.90805
36	10.97282	86	26.21285
37	11.27762	87	26.51765
38	11.58242	88	26.82245
39	11.88722	89	27.12725
40	12.19202	90	27.43205
41	12.49682	91	27.73686
42	12.80163	92	28.04166
43	13.10643	93	28.34646
44	13.41123	94	28.65126
45	13.71603	95	28.95606
46	14.02083	96	29.26086
47	14.32563	97	29.56566
48	14.63043	98	29.87046
49	14.93523	99	30.17526
50	15.24003	100	30.48006

CONVERSION OF METERS TO FEET

Meters	Feet	Meters	Feet
1	3.28083	51	167.32250
2	6.56167	52	170.60333
3	9.84250	53	173.88417
4	13.12333	54	177.16500
5	16.40417	55	180.44583
6	19.68500	56	183.72667
7	22.96583	57	187.00750
8	26.24667	58	190.28833
9	29.52750	59	193.56917
10	32.80833	60	196.85000
11	36.08917	61	200.13083
12	39.37000	62	203.41167
13	42.65083	63	206.69250
14	45.93167	64	209.97333
15	49.21250	65	213.25417
16	52.49333	66	216.53500
17	55.77417	67	219.81583
18	59.05500	68	223.09667
19	62.33583	69	226.37750
20	65.61667	70	229.65833
21	68.89750	71	232.93917
22	72.17833	72	236.22000
23	75.45917	73	239.50083
24	78.74000	74	242.78167
25	82.02083	75	246.06250
26	85.30167	76	249.34333
27	88.58250	77	252.62417
28	91.86333	78	255.90500
29	95.14417	79	259.18583
30	98.42500	80	262.46667
31	101.70583	81	265.74750
32	104.98667	82	269.02833
33	108.26750	83	272.30917
34	111.54833	84	275.59000
35	114.82917	85	278.87083
36	118.11000	86	282.15167
37	121.39083	87	285.43250
38	124.67167	88	288.71333
39	127.95250	89	291.99417
40	131.23333	90	295.27500
41	134.51417	91	298.55583
42	137.79500	92	301.83667
43	141.07583	93	305.11750
44	144.35667	94	308.39833
45	147.63750	95	311.67917
46	150.91833	96	314.96000
47	154.19917	97	318.24083
48	157.48000	98	321.52167
49	160.76083	99	324.80250
50	164.04167	100	328.08333

U. S. Miles to Kilometers		Kilometers to U. S. Miles		Nautical Miles to Kilometers		Kilometers to Nautical Miles	
1	1.6093	1	0.62137	1	1.8532	1	0.53959
2	3.2187	2	1.24274	2	3.7065	2	1.07919
3	4.8280	3	1.86411	3	5.5597	3	1.61878
4	6.4374	4	2.48548	4	7.4130	4	2.15837
5	8.0467	5	3.10685	5	9.2662	5	2.69796
6	9.6561	6	3.72822	6	11.1195	6	3.23756
7	11.2654	7	4.34959	7	12.9727	7	3.77715
8	12.8748	8	4.97096	8	14.8260	8	4.31674
9	14.4841	9	5.59233	9	16.6792	9	4.85634
10	16.0935	10	6.21370	10	18.5325	10	5.39593

METRIC MEASUREMENTS USED IN ITALIAN LUMBER MARKET

The following is an excerpt from The American Lumberman, Chicago, November 23, 1918.

The few cargoes of Spruce from Canada which before the war arrived at Genoa were almost without exception composed entirely of deals in various sizes, as 2x7-inch. — 3x7-inch, — 3x8-inch, — 3x9-inch, — and in various lengths from 10 feet and longer, * * *

The measurements of spruce boards, planks and beams, etc., used in Italy, according to a leading house of lumber importers in Genoa, are as follows:

Small Boards—Thickness, 9 mm. Width, from 120 mm. to 400 mm. (graded), average width being about 250 mm. Length, 4, 4.25, 4.50, 4.75, 5.00 meters.

Boards—Thickness, 14, 18, 24, 28, 34, 44, 48, 54 mm., the greater part in demand averaging 14, 18 and 24 mm. Width and length: As in the foregoing.

Planks—Thickness, 68, 75, 85, 100 mm. Width, 170, 195, 225 mm. Length, 3.50, 3.75, 4.00, 4.50 meters (the greater part averaging 4.50 meters), and up to 10 meters in length, in grades of 25 cm.

Beams, Sawn—Thickness, 150 mm. up to about 400 mm. Length, from 6 meters to 15 meters in grades of 50 cm.

Small Beams, Sawn—Thickness and width, 38x38, 48x48, 58x58, 68x68, 78x78, 88x88, 98x98 mm. Length, 4.00, 4.50, 5.00, 5.50, 6.00 meters, in greater part averaging 4.00, 4.50 and 5.00 meters.

Lath—Thickness and width, 8x25, 28x28, 34x34 mm. Length, 4.00, 4.50 meters.

To generalize, the boards and planks mostly used in Italy are of the following sizes:

Thickness—Boards of 14, 18, 24 mm.; to smaller extent boards of 28, 34, 38 and 48 mm., and to a still smaller extent planks of 54, 68, 75, 85 and 100 mm.

Widths—Classified as follows: (1) sottomisure, which contains boards from 100 mm. to 180 mm.; (2) regular widths, which refer to boards and planks from 190 to 400 mm. and up. The average width of boards asked for is 250 mm.

Lengths—The greatest quantity of boards and planks used in Italy are 4 meters to 4.50 meters in length.

The Interpretation of Grades

Mercantile Quality—For the boards of 12, 18, 24, 28 mm. in thickness there is required lumber of what is called in the trade a mercantile quality, by which is understood boards and planks which tho perfectly sound may contain knots, provided they are neither too numerous nor too large nor loose.

First Quality—A more choice quality of lumber (first quality) is required for greater thicknesses; that is, for boards and planks of 34, 38, 48, 54, 75, 80 and 100 mm. By first quality lumber is understood boards and planks which are perfectly healthy and which contain only few and small knots. Large and numerous knots are not allowable.

It is also understood that the boards and planks should have the parallel form and should be worked square edged.

Railroad Ties

According to the Government specifications the ties cut from the Italian forests to be accepted must have the following minimum measurements: Length, 2.60 meters; widths, 0.24 meters, and thickness, 0.14 meter.

These measurements must be verified at point of delivery and the supplying firm must therefore allow for natural contraction. As the price of the cross ties is based on number and not on contents no allowance is made the supplier for any extra inherent quantity of lumber over the indicated measurements of the specifications. However, a second dimension is also allowed, as follows: Length, 2.51 meters; width, 0.23 meters, and thickness, 0.135 meters. But the number of cross ties falling short of the measurements of the first specification must not be more than 20 per cent. of the total number of ties accepted.

EXPORTERS SHOULD USE METRIC SYSTEM

Dimension should, so far as possible, be given according to the metric system when negotiating with Italian merchants. In fact, the question of making boards and planks in the sizes required by the Italian market could be advisedly studied. According to some importers, it is more important to conform to the standard measurements of the country than to supply the kinds of lumber known and already used, as the Italian consumers eventually would be fully satisfied with the American woods. The Italians do not understand North American technical phraseology. Quotations for running feet are unintelligible and if the metric system is not used at least quotations should be made in cubic feet, which can without difficulty be translated into cubic meters. Adapting oneself to the market with which one is trading, however, is a thing American lumber manufacturers should learn, and the sooner they accustom themselves to the metric system the better.

Italian lumber importers would, it is understood, be ready to pay cash against documents, on the condition, however, that prices are convenient and provided they have at least a clear idea of the quality of timber which they are to receive. Another practice sometimes adopted is 80 per cent. payment on delivery of document and the balance on actual receipt of parcel or cargo.

PACIFIC LUMBER INSPECTION BUREAU, INC.

HEAD OFFICE

1011-1014 WHITE BUILDING, SEATTLE, WASH., U. S. A.
F. W. ALEXANDER, MANAGER
L. C. LAURSEN, CHIEF SUPERVISOR

DISTRICT SUPERVISORS

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R. C. Crakanthorp	913 Metropolitan Bldg.	Vancouver, B. C.
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Fred T. Hayley	2 Purcell Bldg.	Everett, Wash.
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J. S. Kelso	716 Lewis Bldg.	Portland, Ore.
I. F. Richardson	1223 National Realty Bldg.	Tacoma, Wash.

PACIFIC COAST GRADING RULES

Owing to the demand for grading rules by the public the Pacific Lumber Inspection Bureau, Inc., find it necessary to make the following charges as specified below. The "lists" can be obtained from any of the district supervisors, or by addressing the head office at Seattle, direct.

Price List

Atlantic Coast List "A"

Douglas Fir—Western Hemlock—Sitka Spruce and Western Red Cedar
Grading Rules and Price List....40 cents
Grading Rules only....20 cents

Domestic List Number "7"

Douglas Fir—Western Hemlock—Sitka Spruce—Western Red Cedar and Port Orford Cedar.
Grading Rules and Price List.... 40 cents
Grading Rules only.... 20 cents

Export List "H"

Douglas Fir—Western Hemlock—Sitka Spruce.
Grading Rules and Price List.... 40 cents
Grading Rules only.... 20 cents

Grading and dressing rules including diagrams and patterns of the finished sizes of dressed lumber which are recognized as the standard for rail shipments, can be obtained from the following association at 50 cents per copy.

WEST COAST LUMBERMEN'S ASSOCIATION

Henry Bldg., Seattle, Wash., U. S. A.
Lewis Bldg., Portland, Oregon, U. S. A.

LUMBER & SHINGLE MANUFACTURERS, LTD.

Metropolitan Bldg., Vancouver, B. C.

DOUGLAS FIR CAR MATERIAL

Standard specification, grading and dressing rules can be purchased at 10 cents per copy from the WEST COAST LUMBERMEN'S ASSOCIATION, Seattle, Washington, U. S. A. Portland, Oregon, U. S. A.

Lumbermen engaged in the shipment of Foreign Cargoes, should send for MISCELLANEOUS SERIES—NO. 67

THE EXPORT LUMBER TRADE OF THE UNITED STATES

Price, 20 cents
Sold by the Superintendent of Documents,
Government Printing Office,
Washington, D. C.

EXCERPT, FROM MISCELLANEOUS SERIES—NO. 67

THE EXPORT LUMBER TRADE OF THE UNITED STATES

By Edward Ewing Pratt

Formerly Chief, Bureau of Foreign and Domestic Commerce, Washington, District of Columbia

It can not be said in general that the American exporters have succeeded in having their grading rules universally recognized abroad. Disputes as to grades are the most serious obstacle to the selling of American lumber in foreign countries.

It is generally considered that the Douglas Fir inspection and grading rules concerning export shipments are the most satisfactory. Some years ago a bureau of inspection was formed, called the Pacific Lumber Inspection Bureau (Inc.), which is a separate establishment from the lumber associations. This bureau employs licensed inspectors and undertakes at a fixed charge per 1,000 feet to inspect cargoes for export. When the cargo has been found "up to grade" the bureau issues an inspection certificate, sworn to before a notary public and countersigned by one of the supervisors of the bureau, certifying to the quantity, character, and condition of the shipment. This certificate is always accepted as proof of the character and condition of the cargo at port of shipment and relieves the shipping mill from any responsibility for impairment of condition during transit. When the exporter has loaded the cargo he presents the inspection certificate to the bank, together with the draft, bill of lading, insurance policy, and other shipping documents. It is understood that these certificates are of the greatest importance in facilitating the discounting of drafts, because the bank's main security is the value of the cargo.

This bureau has been in existence for fifteen years, and its services are considered very valuable and impartial to both importers and exporters. At present the bureau inspects practically all export shipments of Douglas Fir lumber from the Pacific Coast. Last year's report (1916) states that 13,696 inspection certificates were issued and only four complaints were received—two from Europe, one from South America, and one from Australia. One of these complaints was not concerned with grade.

With grades comparatively unknown in many markets, no general custom of branding, and terms often cash before the cargo leaves port, the American lumber trade needs the services of an Inspection Bureau of the highest standard.

The Pacific Lumber Inspection Bureau has been a very important factor in bringing the West Coast lumber trade into foreign markets.

A certificate of inspection is issued by the Pacific Lumber Inspection Bureau in the following form:

PACIFIC LUMBER INSPECTION BUREAU, INC.

LUMBER INSPECTOR'S CERTIFICATE

.................................., 191....

We I, regularly approved

....

....

....

Lumber Inspector..., licensed by the Pacific Lumber Inspection Bureau (Inc.), and at the time acting in that capacity, do hereby certify that we (I) have personally surveyed and inspected, according to the grading and survey rules as per .... adopted by the West Coast Lumber Manufacturers' Association, the cargo of lumber shipped on board the .... by ...., bound for ...., and the said cargo has been shipped in good order and condition and consists of ....

....

Remarks: ....

....

....

....

Inspector.

Subscribed and sworn to before me, the undersigned, a notary public in and for the ...., by the above-named party, personally known to me as the person signing the above Certificate.

.................................., Notary Public.

Countersigned: ...., Supervisor. Dated: ...., 191....

[This Certificate is not valid unless bearing the seal of the Pacific Lumber Inspection Bureau (Inc.), countersigned by one of its supervisors and free from alterations.]

CALIFORNIA REDWOOD

(Sequoia Sempervirens)

DESCRIPTION

Redwood is lumber from the "big trees" of California—the Eighth Wonder of the World. Scientists call them **Sequoia sempervirens,** which, when translated into our every-day tongue, means "Sequoia ever-living." Sequoia is an Indian name; the name of a chief of great power and influence among his people. It was natural, therefore, for the Indians to name the giant trees after their most powerful chief.

They are wonderful trees. Their living power is without peer among perishable and animal life. The secret of their great age is resistance to rot and fire, and practical immunity to the attack of insect life and fungus growth so destructive to most other kinds of wood. In the forests, the Redwoods have fought decay and fire down the sweep of many centuries—they lived on sturdy and strong while other forest trees matured and died in successive crops.

RANGE

By a freak of nature the Redwoods grow nowhere else in the world but in California. Their range is confined to a strip along the Pacific Coast north of San Francisco Bay to the Oregon State line, and extending inland not more than 10 to 20 miles. The principal stand of commercial lumber today is in the three north coast counties of Mendocino, Humboldt and Del Norte. Their growth ranges from the sea level to an altitude of 2500 feet.

YIELD

The Redwoods grow in what is known as the "fog belt," and thrive only in excessive moisture. There are millions of trees, and estimated by the Government to contain between 50,000,000,000 and 60,000,000,000 board measure feet of lumber—more than enough to keep all the saw-mills now cutting Redwood busy day and night for 100 years. The Redwoods grow big and dense, yielding on the average from 75,000 to 100,000 board feet of commercial lumber per acre. There are quite a number of instances where the Redwoods grow so dense and so big that a single acre has yielded more than 1,000,000 board feet of lumber.

CALIFORNIA REDWOOD—Continued

HEIGHT

The Redwood forest is one of the sublimities of nature. The massive trees, with their straight trunks covered with cinnamon-colored bark and fluted from the base to the apex of the tree like a Corinthian column, are as impressive as the cold, silent walls of an ancient cathedral. They grow from 5 to 25 feet in diameter, and from 75 to 300 feet in height. The great size and height of these trees can best be appreciated when it is known that, if hollowed out, one of the large Redwoods would make an elevator shaft for the famous Flatiron Building in New York; in height it would tower 50 feet above the torch of the Statue of Liberty in New York Harbor! They are so large that a single tree has produced enough lumber to build a church at Santa Rosa, California, that will seat 500 people.

The enormous logs make it necessary to use the most powerful and expensive logging machinery. Many of the large logs must be split with gun-powder before they can be handled on the saw carriage at the mill. It is not uncommon for a butt log (the first cut above the ground) to weigh from 30 to 50 tons, according to the diameter of the tree. The butt cut is usually 16 feet in length.

ROOT FORMATION

One of the strange things about the Redwoods is the root formation, which is slight in comparison with the size of the tree. Redwood actually has an insecure footing. There is no tap root to push straight down into the earth to give the tree stability. The roots radiate a few feet below the surface of the soil. It is supposed they protect themselves by dense growth. The floor of the forest is covered with a luxuriant growth of magnificent ferns and beautiful rhododendrons.

THE BIG TREES OF CALIFORNIA

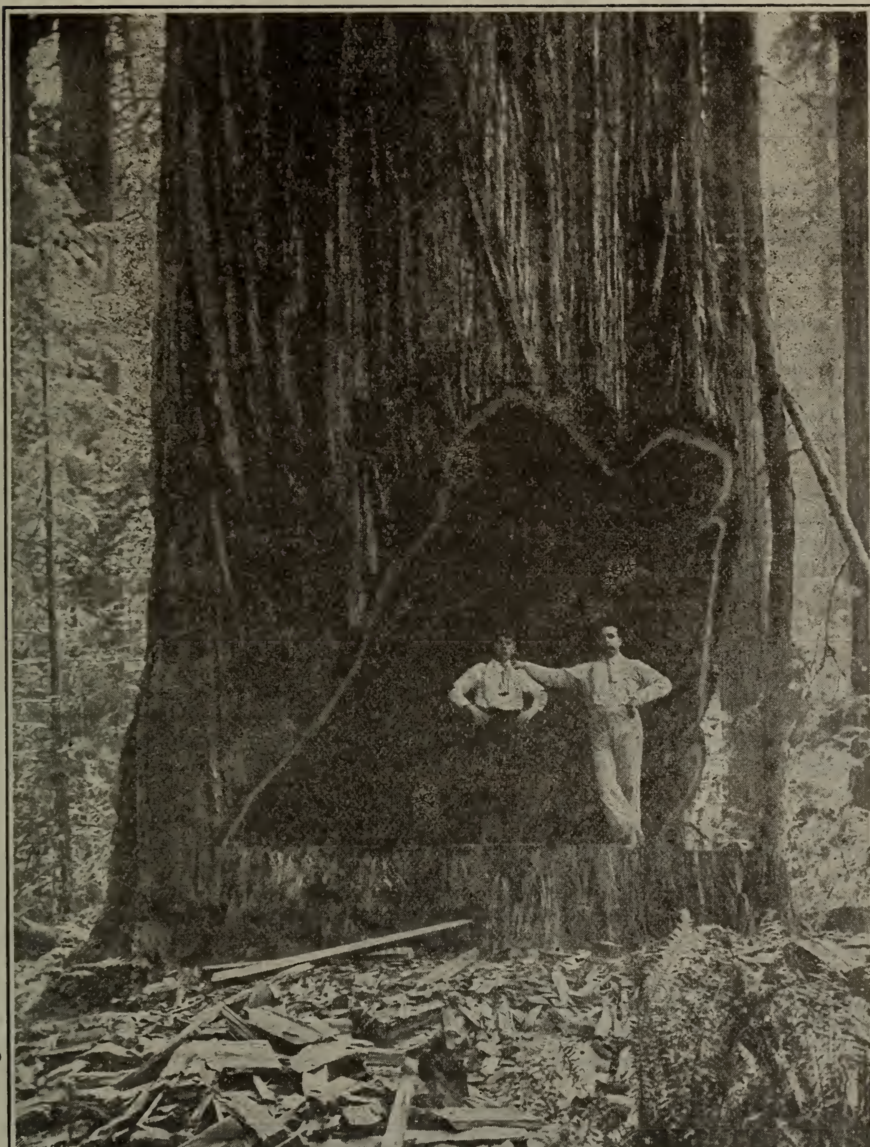
DESCRIPTION

The **Sequoia gigantea,** or **Sequoia washingtonia,** as the United States Forest Service refer to them, are the "big trees" of the tourist. They are first cousins of the Redwoods. Geologists assert that they are the lone living survivors of all plant and animal life that existed before the glacial age. The few remaining trees are confined to an area of about 50 square miles on the western slope of the Sierra Nevada Mountains, in central California, and of which the Yosemite Valley is a part. Many of these trees are 4000 years of age—and some bold scientists have estimated one to be from 8000 to 10,000 years old! They are located in an altitude of from 4000 to 7000 feet above sea-level, and bear evidence of having passed maturity and are in their decline. If the decline lasts proportionately as long as it took the trees to reach maturity, they are still good for untold centuries. Thes "big trees" are found only in protected valleys and spots in the mountains, indicating the cause of their survival of the glacial upheaval.

THE GRIZZLY GIANT

The "Grizzly Giant" in Mariposa Grove, Yosemite Park, is 91 feet in circumference at the ground, and its first branch, which is 125 feet from the ground, is 20 feet in circumference. The "General Sherman" is 280 feet high, 103 feet circumference at the ground, which means a diameter of 36½ feet, and at a point 100 feet from the ground it is 17.7 feet in diameter. These are two of the most noted of the "big trees."

The "big trees" of California afford an inexhaustible reservoir of information for the scientist who reads this story of the past by the study of the annular growth. By means of this he is able to determine the season and locate with a degree of definiteness climatic conditions and changes on the Pacific Coast as far back as 4000 years ago!



CALIFORNIA REDWOOD

(Sequoia Sempervirens)

SAP

Sap is always white. Some manufacturers make a specialty of turning out a "sappy clear" grade. Lumber of this description shows a streak of white along one edge and presents a most beautiful contrast between the red and white in the wood. This "sappy clear" is highly prized for interior finish.

COLOR AND GRAIN

In color Redwood shades from light cherry to dark mahogany; its grain is straight, fine and even. The color and grain present in combination a handsome appearance. It runs strong to upper grades, and phenomenal widths, sometimes as wide as 36 inches, entirely free from check or other defects.

PAINTING AND POLISHING

Redwood is easily worked, and when properly seasoned it neither swells, shrinks, nor warps—it "stays put," and being free from pitch takes paint well and absorbs it readily. The dark color of the wood makes three coat work necessary, since the priming coat must be mixed extremely thin to fully satisfy the surface. It also takes a beautiful polish, especially if given two coats of shellac and then a wax finish on top.

INTERIOR AND EXTERIOR FINISH

For doors, windows, pattern or panel work, wainscoting, ceiling, casing, shelving, moulding, and every description of interior or exterior finish the finest results can be obtained. For interior finish Redwood should not be painted any more than you would cover oak or mahogany. Redwood's beauty for interior finish lies in its individuality, its soft, warm tone and color possibilities.

QUALITY

Redwood is the most durable of the coniferous woods of California and possesses lasting qualities scarcely equalled by any other timber. Although very light and porous, it has antiseptic properties, which prevent the growth of decay producing fungi. So far as is known, none of the ordinary wood rotting fungi grow in Redwood timber. This is an exceedingly valuable property which should extend the use of this wood for all kinds of construction purposes.

DURABILITY

For tanks, stave water pipe, poles, posts, paving blocks or foundations, it will last almost indefinitely under the trying conditions of being placed in contact with the ground and subject to alternate wet and dry conditions.

For exterior boarding, finish and shingling, whether painted or not, its durability in thousands of instances has been demonstrated to be very great.

PATTERN WORK

Leading engineering and shipbuilding works in California have been using Redwood for pattern work during the past twenty-five years, as it works easily and time has proved that it retains it shape as well as any other wood used for this purpose.

CAR MATERIAL

Redwood is in great demand for all kinds of finish for car material. Its special recommendations for this class of work are its durability and well known fire resisting qualities. Examinations of car siding in use for twenty years have failed to show traces of dry rot or any other form of decay.

The hardest service to which wood can be subjected is the railway tie.

It is not only in constant contact with the ground, but it must stand the strain and stresses of swiftly-moving heavy trains. In his report on "Timber, An Elementary Discussion of the Characteristics and Properties of Wood," to the Division of Forestry, U. S. Department of Agriculture, Filbert Roth, special agent in charge of timber physics, gives the following table on

THE RANGE OF DURABILITY IN RAILROAD TIES

Redwood	12	Elm	6 to 7
Black Locust	10	Long Leaf Pine	6
Oak (white and chestnut)	8	Hemlock	4 to 6
Chestnut	8	Spruce	5
Tamarack	7 to 8	Red and Black Oaks	4 to 5
Cherry, Black Walnut Locust	7	Ash, Beech, Maple	4

To get best service out of the Redwood tie under heavy equipment, tie plates should be used.

Redwood ties are in big demand in South America, England and the continent, Australia and the Orient, because of its resistance to decay and resistance to attack of destructive insects so common in the tropical countries.

HOLDING OF SPIKES

Respecting the "holding of spikes" Redwood ties compare favorably with all other ties ordinarily classed as soft wood.

REDWOOD AND THE TEREDO

The Teredo will attack and destroy Redwood piles or timber as quickly as any other wood.

REDWOOD AND THE WHITE ANT

Owing to its immunity from the ravages of the White Ant, this wood is almost exclusively used in the Philippine Islands for cabinets and boxes to hold important documents.

FIRE RESISTING QUALITIES

Redwood, owing to its freedom from pitch, will not ignite easily nor make a hot fire when burning and is very easily extinguished.

It is an actual fact that fires have been extinguished in Redwood buildings with comparatively slight damage, when the same fire would have made practically a total loss had the buildings been constructed of pine or cedar. The reason is plain. Redwood is not slow in combustion, but absorbs moisture readily and when moistened, resists fire wonderfully.

REDWOOD SHINGLES

Redwood shingles as a roof or side wall covering give long life and fire protection.

No other shingle, or substitute roof covering gives the ideal combination of rot resistance and fire retardance, with the additional merit of being rust proof and free from tar, gum or any other substance to melt in the sun and fill gutters, water pipes or drains.

Always lay Redwood shingles with zinc-coated cut iron nails. This will prolong the life of your roof many years. The ordinary steel shingle nail will rust out while the shingle itself is still in first-class condition. A Redwood shingled roof, laid with the right kind of nails, will give satisfactory service from 30 to 50 years.

You can buy Redwood shingles in two grades, No. 1 Clear and Star A. Star. The former is a carefully selected vertical grain shingle, free from all defects, and is used invariably on coverings where service demands first consideration. The latter is a 10-inch clear butt shingle, "slash" grain being no defect, and it is recommended for side walls rather than for roofing.

In 1893 Redwood shingles were taken from the roof of General U. S. Grant's headquarters, at Fort Humboldt, California, where they had been for 40 years. The wood was absolutely sound and without a trace of rot, although the **shingles were worn thin by wind-driven sand.**

REDWOOD LATH

Redwood lath have given most satisfactory service for many years, the fire-retarding property of Redwood giving lath of this material a decided advantage over the ordinary kinds. For best results the rough coat of plaster should be allowed to dry thoroughly before applying the finish coat.

GROWS STRONGER WITH AGE

Redwood actually grows stronger with age! This has been demonstrated by tests made at the University of California. Timbers taken from a house built 37 years ago, on the Campus of the University, at Berkeley, were tested and found to be actually stronger than the day when the building was erected. There wasn't the slightest trace of decay in these timbers, and when sawn the wood was virile and healthy in color and texture. Air seasoning had taken place under the most favorable conditions.

The 37-year Redwood had a longitudinal crushing strength one-quarter greater than Redwood which had been air seasoned two years.

WEIGHT OF REDWOOD LOGS

Butt logs absorb so much moisture that the first and second cuts usually sink in water. Left in the sun they require three to four years to dry.

A STRONG WOOD FOR ITS WEIGHT

Seasoned Redwood is one of the strongest woods for its weight. Dry Redwood weighs 26.2 pounds per cubic foot—slightly less than Cypress, which weighs 27.6. It is equal in strength to Cypress; and its breaking strength, according to U. S. Government figures, is 62 per cent of that of White Oak, which is one of the strongest and toughest of American woods.

The standard of lumber weight and measure is based on a "board-measure" foot. A board-measure foot means a piece one inch thick and 12 inches square. One-inch boards, in the rough, dry, weigh 2400 pounds per 1000 board-measure feet. The same boards dressed smooth on two sides would weigh 2000 pounds, and if dressed four sides will weigh 1800 pounds.

WEIGHT OF REDWOOD FOR EXPORT CARGO SHIPMENTS

"Green" Redwood for cargo shipment weighs about 5 pounds per board foot. A simple method for computing the shipping weight is to multiply the board feet by 2.2 per thousand, this gives the weight in tons of 2240 pounds.

The weight in tons of 2240 pounds of seasoned redwood boards is computed by multiplying the board feet by 1.1 per thousand.

Redwood is frequently shipped to Foreign Ports in conjunction with Douglas Fir cargoes. In steamer shipments it is customary to stow "green" Redwood first in lower hold and dry Redwood in the Bridge space, Shelter deck or 'Tween decks. Douglas Fir is loaded last in the balance of space under deck and on deck. The object of combining Redwood and Douglas Fir cargoes is to balance the weight so as to carry the maximum amount of cargo with a minimum of water ballast.

Under ordinary circumstances a combined cargo with weight of lumber correctly balanced and stowed should only require one third the amount of water ballast that would be necessary with a straight cargo of Douglas Fir.

Redwood immersed in salt water or otherwise exposed to its action will gradually blacken on the surface and for this reason it should not be shipped on deck unless precautions are taken to protect it from the elements.

The exact proportion of green and seasoned redwood and Douglas Fir to obtain the best results cannot be given as so much depends on the specifications type of vessel and intelligent stowage.

The following proportions will give good results under usual circumstances for an ordinary tramp steamer.

20%	of cargo	Green Redwood
15%	"	Dry Redwood
65%	"	Douglas Fir

If pickets or lath are not available for stowage, about 5% of cargo in Redwood doorstock would be a good substitute.

CALIFORNIA REDWOOD GRADES

Adopted April 5, 1917 by California Redwood Association
San Francisco, California

SPECIAL NOTES

1. All worked lumber shall be measured and invoiced for contents before working.

2. All rough lumber unseasoned shall allow an occasional variation equivalent to 1/16 of an inch in thickness per inch and 1/32 of an inch in width per inch.

3. All rough lumber seasoned shall allow a variation equivalent to 3/32 of an inch in thickness per inch.

4. All rough lumber seasoned shall allow a variation in width as follows:
   6-inch and less, ¼ of an inch in width.
   8, 10 and 12 inch, ½ of an inch in width.
   14-inch and wider, ¾ of an inch in width.

5. Surfaced lumber will be ⅛ of an inch less for one side and 3/16 of an inch less for two sides. Rustic, T. & G., T. G. & B. will be 3/16 of an inch less for one side and ¼ of an inch less for two sides. (Above less than rough thickness.)

6. Grain of all grades shall be as the lumber runs.

7. Worked lumber to be in accordance with patterns adopted by California Redwood Association, April 5, 1917.

KNOTS

In these Grading Rules, knots are classified as sound, loose and soft.

A Sound Knot, irrespective of color, is solid across its face, as hard or harder than the wood it is in, and so fixed by growth or position that it will retain its place in the piece.

A Loose Knot is one not held firmly in place by growth or position.

A Soft Knot is one not so hard as the wood itself.

GRADES

Uppers

(Under the heading of Uppers shall be included all Redwood of a grade higher than Extra Merchantable. including Clear. Sap. Select. Standard, Pickets, Battens, etc.)

Clear: Shall be good and sound, free from knots, shakes or splits. Will allow a reasonable amount of birdseye, and sap not exceeding four per cent of the area of all the surfaces. A fair proportion in each shipment may contain pin knots showing on one face only.

Sap Clear: Shall conform generally to the grade of clear, except that it may contain any amount of sap. Discolored sap, when sound, shall not be considered a defect.

CALIFORNIA REDWOOD GRADES—Continued

Select: Shall be good and sound, free from shakes or splits. Shall be graded from the face side and will allow birdseye and one small, sound knot one inch in diameter or its equivalent in each six superficial feet. In the absence of other defects, will allow one soft knot one-half inch in diameter in each six superficial feet. Sap allowed not exceeding four per cent of the area of all the surfaces.

Standard: Shall be graded from the face side and will allow birdseye, any amount of sap, and in each six superficial feet, two sound knots not exceeding an inch and a quarter in diameter, or their equivalent. In the absence of sound knots, will allow one soft knot one inch in diameter or its equivalent in each six superficial feet.

Clear, Sap Clear and Select Worked: Shall be well manufactured and worked smoothly to uniform thickness. Will admit of slight roughness or variation in milling, and defects mentioned under grades of Clear, Sap Clear and Select.

Standard Worked: Will admit in addition to stock of regular Standard Grade, Clear, Sap Clear, and Select, which, owing to poor machinery, is unsuitable for these grades.

SUNDRY COMMONS

(Under the heading of Sundry Commons shall be included Extra Merchantable, Merchantable, Construction, Shop, etc.)

Extra Merchantable: In one inch shall be free from shakes and splits. Will admit any number of sound knots, but not more than one knot two and a half inches in diameter, in each five superficial feet, and small, soft knots that do not materially affect the strength or usefulness of the board. Will allow sap not exceeding ten per cent of the area of all the surfaces.

In dimension Extra Merchantable shall consist of sound lumber free from shakes, large loose knots, or such other defects as would materially impair its usefulness. Will allow sap not exceeding ten per cent of the area of all the surfaces.

Extra Merchantable Rustic and Shiplap: This grade shall conform to the grade of Extra Merchantable, except that Sap in any amount shall be allowed.

Construction: Shall be suitable for ordinary construction. Will allow sap, loose and soft knots, shakes and other defects, and splits not extending over one-sixth the length of the piece.

Merchantable: This grade is recommended for general building purposes. It consists of sixty per cent Extra Merchantable and not to exceed forty per cent Construction.

Shop: There shall be but one grade in Shop.

Inch Shop: Each piece shall contain not less than fifty per cent of cuttings five inches and wider and three feet and longer, having no defects except sap.

Inch and a Quarter to Two-Inch Shop: Each piece shall contain not less than fifty per cent of two face clear cuttings, exclusive of sap, five inches and wider, and of this fifty per cent of clear cuttings forty per cent shall be suitable for door stiles six feet seven inches and longer.

Two and a Half Inch and Thicker Shop: Shall contain sixty per cent of clear cuttings five inches and wider and two feet and longer.

HOW TO OBTAIN ADDITIONAL INFORMATION REGARDING CALIFORNIA REDWOOD

The California Redwood Association has been organized by the manufacturers of this remarkable lumber for the purpose of supplying the public or prospective buyers with accurate and dependable information about Redwood.

Letters of enquiry will receive prompt and cheerful attention when addressed to the

California Redwood Association
Call Building
San Francisco, Calif., U. S. A.

WESTERN OR SITKA SPRUCE

(Picca Sitchensis)

In comparison with other soft woods in the United States that are used for lumber, Western Spruce also known as Sitka and Pacific Spruce, is particularly clean and white, of a soft texture with tough fiber and has a beautiful sheen or glow peculiar to itself.

WESTERN AND EASTERN SPRUCE COMPARED

Comparing Western Spruce with the Spruce of the Eastern States, it bears the same relation that the large tree does to the sapling. The Western Spruce grows very large, the average size of the logs being nearly four feet in diameter, while the average diameter of the Eastern Spruce is less than one foot.

The small tree is fine grained and contains many small red knots, while the larger tree is coarser in grain with a much larger percentage of clear, and what knots occur in the body of the tree are usually black and loose.

USE FOR FINISH

The uses for which Spruce is best adopted are finish, siding, doors, sash, factory work, musical instruments and boxes, especially those for containing pure food products.

Because Spruce is the best substitute for White Pine, now becoming scarce, it is used by sash and door factories in the manufacture of doors, windows, mouldings, frames, etc., and is found to be a very satisfactory wood for these purposes.

BOXES FOR FOOD PRODUCTS

Many of the manufacturers of spruce on the Pacific Coast have box factories and the lower grades are manufactured into box shooks for all purposes. The spruce lumber, however, should be reserved for use in those boxes which are to contain food products, such as crackers, corn starch, butter, dried fruits, etc., because it is so clean, sweet and odorless that it does not taint these substances. It is also largely used for eggs cases to be placed in cold storage, because eggs will taste if packed in boxes made from pine or wood containing pitch. Spruce is used for lining refrigerators for the same reason.

SECRET OF SURFACING

There has been a great deal of complaint on the part of those who have bought and tried to work spruce because it works so hard. The factory man who was used to white pine with its short and brittle grain, has been disappointed because his methods did not bring the same results with spruce. There is but one secret about spruce and the man who knows this can get first class results without special effort. The secret is to have the wood thoroughly dry and use sharp knives. The fiber of spruce, being long and tough when wet, cuts very hard, but when dry there is no difficulty if the knives are sharp.

SPRUCE—Continued

HOW TO GRIND KNIVES FOR DRESSING SPRUCE

The cut shows the back bevel on the planer knife successfully used by planing mill experts for surfacing "Green" or "Dry" Spruce. When the knife is ground with the bevel as illustrated, it makes a square cut and leaves a smooth surface, as it breaks off the chip instead of tearing it away from the board.

QUALITY

Spruce grades are always good because of the character of the wood. The principal defect is knots and as these are largely black and loose, the wood must be cut up into practically clear lumber. After this is done, the grade is likely to be satisfactory to any buyer.

Spruce has just the right texture to receive and hold paint nicely and is the best known wood for making sign boards, first, because any size and length can be secured, and second, because two coats of paint on spruce will give as good a finish as three coats on almost any other soft wood.

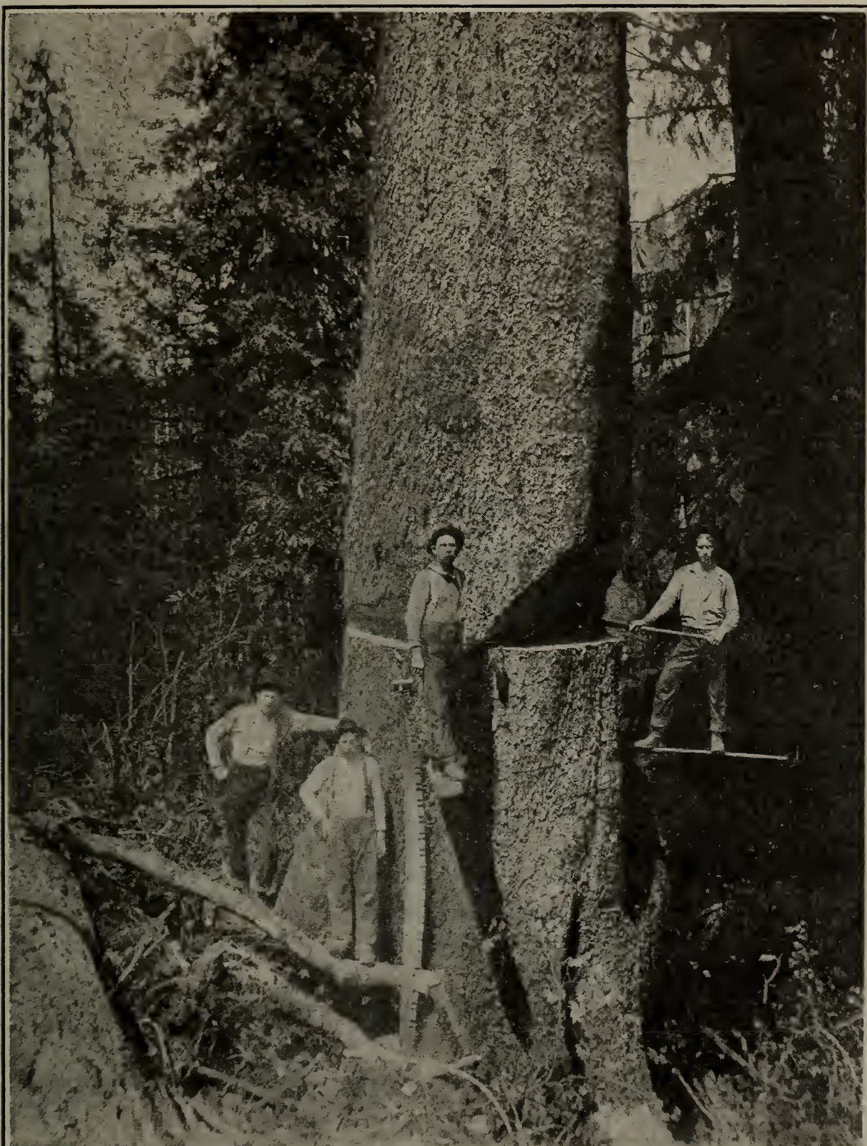
The spruce trees of the Pacific Coast are so large that the percentage of sap is small, indeed. For this reason spruce does not stain or discolor easily, even if the lumber is placed where it will become mouldy, the blue mould will dress off with a very light cut.

The above statement regarding the spruce of the Pacific Coast will enable the buyer to judge whether it is adapted to his purpose.

SPRUCE FOR AIRPLANES

Western Spruce is the ideal wood for airplane construction it is the toughest softwood for its weight, possesses tremendous shock absorbing qualities, and does not splinter when hit by a missile, it is used in the frames of airplane wings, ailerons, fins, rudders, elevators, and for the stabilizers, the struts, landing gear, fuselage, flooring, engine bed, after-deck, and even the seats are made of it. About 350 pieces of spruce are required in a single airplane, but not all of them are individually different; the wing beams are practically of similar dimensions, and the struts vary only in size according to the strains put upon them.

Roughly, the specifications for spruce parts are: Straight grain, clear from knots and defects so as to give maximum strength. The size of the rough pieces must be such as to insure a finished dimension after deducting losses for finishing, checking and shrinkage. Desirable pieces run 1¼ inch to 3 inches thick, 3 inches and upward in width, and from 5 feet to 17 feet in length. Practically all the available spruce is in the United States and along the western coast of British Columbia. In this country, it grows close to the Pacific coast on the western slopes of the Cascade range in the States of Washington and Oregon. The stand of Sitka spruce, which is the best airplane stock, in these two States is estimated at 11,000,000,000 feet. But less than half of it is near enough to transportation facilities, or in dense enough stands to be commercialized.



WESTERN OR SITKA SPRUCE

(Picca Sitchensis)

WESTERN HEMLOCK

(Tsuga Heterophylla)

The wood of Western Hemlock is light, fairly soft, strong and straight-grained. It is free from pitch or resin. Its strength and ease of working distinguish it from the Eastern Hemlock **(tsuga canadensis and tsuga caroliniana).** For ordinary building purposes Western Hemlock is equally as useful as Douglas Fir. It is manufactured into the common forms of lumber, and sold and used for the same purposes as Douglas Fir. It is suitable for inside joists, scantling, lath, siding, flooring and ceiling; in fact, it is especially adapted to uses requiring ease of working, a handsome finish or lightness combined with a large degree of strength. For the manufacture of sash and door stock, fixtures, furniture, turned stock, wainscot and panel it is recognized as a wood of exceptional merit. It is also largely used in the manufacture of boxes and shelving.

The true value of Western Hemlock timber has not been appreciated on account of its name, since it has been confused with the Eastern Hemlock, which produces wood of inferior quality.—"Forest Trees of the Pacific Coast," by George B. Sudworth.

INTERIOR FINISH

Unlike its Eastern relative, Western Hemlock contains a good proportion of uppers. The clear grades are specially suitable for inside finish, are not easily scratched and when dressed have a smooth surface with a satin sheen, susceptible of a high polish. It will also take enamel finish to perfection, and is well adapted to use as core stock for veneered products. If sawn slash the figure of the grain presents a beautiful effect. The wood is non-resinous and odorless (when dry.)

FLOORING

Vertical Grain Hemlock makes an exceptionally satisfactory flooring. It hardens with age and as a proof of its lasting and wearing qualities the Hemlock floor laid in the Court House of Clatsop County, Oregon, was according to Judge Trenchard in good condition when the building was torn down, after 50 years continual service.

In the Judge's old home, built in 1860, the Hemlock flooring is in excellent condition and so hard that it is now difficult to even drive a tack into it.

BEVEL SIDING

Millions of feet of Clear Western Hemlock are annually manufactured into Bevel Siding. It is a great competitor of Spruce, which it closely resembles, and is often bought or sold as such, either through ignorance or misrepresentation.

USE FOR LIGHT CONSTRUCTION

For sheathing, shiplap, roof or barn boards Western Hemlock is an ideal wood; it is noted for holding nails well, is free from pitch or gum, and the knots in merchantible grades are firm and small. For sanitary reasons it should have a decided preference in the construction of dwelling houses, as it is practically proof against insects, vermin or white ants, and is shunned by rats and mice.

MINING TIMBERS

Entire or part cargoes of Western Hemlock timbers, ties and planks are regularly shipped from the States of Washington and Oregon into California or Mexico, where the lumber is generally used for mining purposes.

PULP WOOD

Many millions of feet of Hemlock are yearly converted into pulp for the making of paper. Practically all of the Hemlock on the Columbia River is used for this purpose by the mills of Oregon City and La Camas.

BOXES AND PACKING CASES

Boxes or Packing Cases manufactured out of Hemlock compare very favorably with other woods used for this purpose. A great number of Hemlock oil cases are shipped to the Orient. One firm in Washington is exporting 50,000 cases per month to Hong Kong and Singapore.

WESTERN HEMLOCK—Continued

WEIGHT

Though Hemlock is very heavy when green, after seasoning it will weigh from 300 to 500 pounds per 1,000 board feet less than Douglas Fir. When paying from 40 to 50 cents per hundred pounds for freight by rail, it means an additional profit that a business man should not lose sight of in cases where the competitive price of other woods is close.

GRADING

The same grading rules that apply to Douglas Fir are generally used for Hemlock.

KILN DRYING

The regular and even structure of the wood and total absence of pitch renders it capable of rapid kiln drying at high temperature without injury.

STRENGTH

The strength of Western Hemlock will be found in the table "Average Strength Values for Structural Timbers" (Page 7).

WESTERN HEMLOCK FOR FOREIGN CARGO SHIPMENT

Buyers and sellers of Western Hemlock will find it to their advantage to act on the following suggestions:

Freshly sawn Hemlock is very heavy and often weighs from four to six pounds per board foot and if shipped in this condition, it displaces more deadweight than Douglas Fir.

The ordinary tramp steamer will carry about ten per cent. more in board feet measurement of Douglas Fir than Hemlock, therefore it would not be good policy to ship a straight cargo of freshly sawn Hemlock.

If Hemlock is shipped in amounts of ten to fifteen per cent. of cargo, it should be a paying proposition if stowed first in lower hold, as the heavy weight in the bottom of the vessel will increase the stability and should cause a reduction of water ballast. This equalizes matters as the extra weight of the Hemlock displaces water ballast upon which no freight is paid.

SIZES BEST ADAPTED FOR CARGO SHIPMENT

The following sizes and lengths can be manufactured to advantage, make good stowage, and can be used with satisfactory results for house construction or similar work.

CLEAR GRADES

1x3 to 1x12—8 to 24 feet long.
2x3 to 2x12—8 to 24 feet long.

MERCHANTABLE GRADES

1x3 to 1x 8—8 to 24 feet long.
2x3 to 2x12—8 to 32 feet long.
3x3 to 3x12—8 to 32 feet long.
4x4 to 4x12—8 to 32 feet long.

SIZES FOR RE-SAWING PURPOSES

It is not advisable to ship Hemlock timbers or sizes of 6 inches in thickness or over, that contain boxed heart, if they are to be used for re-sawing purposes, as Hemlock usually opens up shakey at the heart, and this would cause a loss to the buyer, and result in general dissatisfaction.

WESTERN RED CEDAR
(Thuja Plicata)

This cedar is by far the largest of the four true cedars in the world. Since ancient times cedar has been famous for its resistance to decay and its remarkable durability. Western Red Cedar combines these qualities in the highest degree. The wood is exceptionally light, soft, and of close straight grain, making it easy to handle and work. It is free from pitch. Its qualities render it free from warping, shrinking or swelling.

Western Red Cedar is unsurpassed by any other wood where durability, lightness of weight or ease of working are essential. It also is an excellent wood for exterior siding, finish, corrugated decking and porch flooring, battens, porch columns, newels, lath, common boards, flume constructions, drains, canoes, rowboats, trellis-work, hothouse frames and sash, and for all other purposes in which the material used is exposed to the weather or comes in contact with damp soil. Cabinet makers use it for many purposes, including the backs and sides of drawers, shelves, boxes, and partitions.

From Western Red Cedar is made sixty-six per cent of all wooden shingles used in the United States. The red cedar shingle satisfies architecture's basic requirement of combining, utility, durability and beauty.

Western Red Cedar shingles are not a fire-hazard.

The life of a Western Red Cedar shingle roof is determined by the life of the shingle nail used. Such a roof put on with an old-fashioned iron nail coated with pure zinc should last from thirty to forty years. A soft bright wire nail, on the other hand, is sometimes eaten out by the decay-resisting chemicals in the wood so that the life of the roof is greatly shortened. The same applies to the use of the so-called galvanized shingle nail, which, however, may resist the chemical action of the wood for from eight to ten years.

A Western Red Cedar roof will not rot, rust or corrode. Its light weight saves expense in the whole structure of the house. Such a roof is not torn off by wind or storm. It will not require constant up keep and painting. It is noiseless during heavy rain and hail storms. It is a non-conductor of heat and cold. It is easily put on.

RED CEDAR SHINGLES

The standard length of shingles is 16 inches. The expression 6 to 2 and 5 to 2 means that the butt ends of 6 and 5 shingles, respectively, equals 2 inches in measurement. One bunch contains 25 double courses. One double course contains 10 pieces estimated at 4 inches wide. Four bundles are reckoned to the thousand.

One thousand feet log scale will make ten thousand shingles. When shingles are shipped by vessel, freight is usually paid at the rate of 10,000 shingles being equal to 1,000 feet Board Measure.

One thousand shingles can be stowed in a space equal to 10 cubic feet.

To estimate the number of shingles required for a roof when laid 4 inches to the weather, multiply the number of square feet of roof surface by 9.

It is easy to see why the foregoing rule is correct. Each shingle is 4 in. wide and 4 in. only of its length are left exposed, hence it covers 16 sq. inches, or 1/9 of a square foot—9 shingles will cover a square foot.

Estimators usually allow 1,000 shingles to each 100 square feet of roof surface.

To find the number of shingles equal to 1 square foot:

When laid 4 inches to weather, multiply by 9.
When laid 4½ inches to weather, multiply by 8.
When laid 5 inches to weather, multiply by 7 1/5.
When laid 6 inches to weather, multiply by 6.

APPROXIMATE WEIGHT

1000 shingles, kiln dried, weigh 160 pounds.
1000 shingles, green, weigh 200 to 240 pounds.

To find approximate amount of shingles that can be loaded in a box car, ascertain the capacity of car in cubic feet, add two ciphers to this amount and the result will be the number of shingles required.

HOW TO BUILD A FORTY YEAR ROOF

Much of the following is taken from the American Lumberman Magazine First Prize answer in their International contest "How to Make a Forty-Year Roof."

The first essential is Rite-Grade Red Cedar Shingles. Second, nails, valleys and flashings the equal of good shingles. A roof is only as strong as its weakest part.

For Rafters use sized 2x4s or 2x6s, spaced on not over 2-foot centers, spiked solid and braced as load requires.

For Roof Boards or sheathing use good material, S. I. S. strips 1x4 inches or random widths to not more than 8 inches, spaced not more than two inches apart and nailed solid with 8d nails. Where building paper insulation is used shiplap solid instead of 1x4 inches.

Preparation of Shingles—If they are to be stained use dry shingles, dipping each one in the stain not less than 12 inches from butt. Shingles that are not to be stained should be wet thoroughly before laying. Stained shingles to be wetted before laying (allow time for stain to take full effect).

If additional fire-resistant quality is wanted, dip in good quality of mineral paint or such other approved fire-resistant treatment as may be available.

Shingle Nails—Solid copper, solid zinc, hot-dipped zinc coated or pure iron nails preferred. Where these are not available use old fashioned cut nails.

Size of Nails—For 5 to 2 inches or thinner shingles, 3d; for thicker shingles, 4d.

Laying the Shingles—Start at eaves and lay first course 2-ply, giving first course 1¼ inches projection over crown mold and 1-inch projection at gables.

On one-third or more pitch lay 16-inch shingles 4½ inches to the weather; on less than one-third pitch lay 16-inch shingles 4 inches to the weather. On one-third or more pitch lay 18-inch shingles 5½ inches to the weather; on less than one-third pitch lay 18-inch shingles 4½ inches to the weather.

Use a straight edge to make sure courses are laid straight.

Break all joints at least 1¼ inches (sidelap), seeing that no break comes directly over another on any three consecutive courses, thereby covering all nails.

Nail shingles 6 inches from butt (for 4½-inch to weather) and ⅝ to ¾ inch from sides, and put only two nails in each shingle. Slash grain shingles need nails not over 6 inches apart. Shingles wider than 9 inches should be split.

Lay shingles so that water will run with the grain and do not drive nail heads into shingles.

Lay wet shingles with butts close together. Do not lay shingles dry, unless dipped in non-absorbent paint; then lay ⅛ inch apart.

Use 14-inch best quality old-style tin, heavily coated, for valleys, or copper. Same for ridge roll.

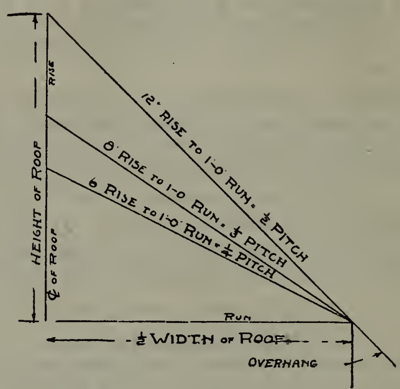
Use heavily coated tin flashing around chimneys.

Finish hips by laying a course of even width narrow shingles on both sides of hip over regular courses.

ROOF PITCHES

This diagram shows the three standard roof pitches that are used by all carpenters who put up buildings. But some good workmen are not sure of all the terms that are used to describe them.

Pitch means the angle or slant of the rafters in a straight line from the eaves to the peak of the roof.



Rise means the vertical elevation of the rafter at a given point. The term "rise" is always used in connection with the term "run." A roof rises a certain number of inches to each foot of the run.

Run is the horizontal measurement from the plate to the center line of the building.

Rise is the vertical climb of the rafter expressed in feet.

For example, the rise of a half pitch roof is equal to the run, which means that the distance from the plate to the center line of the building is the same as the distance from the center line to the peak. The rise of a one-quarter pitch roof is just half as much.

PORT ORFORD CEDAR; LAWSON CYPRESS
(Chamaecyparis Lawsoniana)

On account of its great beauty as an ornamental evergreen, Lawson Cypress, the Port Orford Cedar of lumbermen, is widely known in this country and abroad. It is little known, however, as a forest tree. It is the largest of its genus and also the largest representative of its tribe (Cupressineoe) in North America.

THE WOOD

Port Orford Cedar, also known as White Cedar, is very fine grained, and in color is creamy white, with the slightest tinge of red. The wood has a pleasant rose aromatic odor, which is strong when freshly sawn, but not so pronounced after seasoning. It is a rather hard and firm wood, works as easily as the choicest pine, and is very durable without protection under all sorts of exposure. Experiments have proven that it can be stained to imitate mahogany more closely than any other wood.

It is susceptible to a high polish, and possesses all the features necessary to class it as an excellent material for the better class of interior finish. It is also considered very desirable for airplane material, boat building, shelving, chests and wardrobes where expensive furs and valuable clothes are kept, as its odor is an absolute preventative from the attacks of moths. Its straight grain and the facility with which it is worked gives this wood a high place among those used for match and pattern making.

Nearly all the knots are rotten, in fact in many cases nothing remains but the hole where the knot formerly existed. In spite of this defect, however, the surrounding wood does not decay but is practically everlasting.

FACTORY LUMBER

A large percentage of No. 3 Common would cut up into the best grade of **factory lumber,** as the knots usually of standard size are wide apart, say at intervals of 4 to 10 feet, and outside of this defect the lumber is clear without blemish.

SHIPPING PORTS

The shipping ports are Coos Bay, and Coquille River, Oregon, consignments destined for the United Kingdom or other Foreign Ports, would probably be reshipped at San Francisco.

As this wood splits easily, great care should be exercised in the handling to avoid breakages.

WESTERN LARCH
(Larix Occidentalis)

Western Larch is the largest and most massive of North American Larches. Its straight trunks grow ordinarily to a height of from 100 to 180 feet, and to a diameter of 3 or 4 feet. Not infrequently trees reach a height of over 200 feet and a diameter of from 5 to 8 feet. The tapering trunks are clear of branches for from 60 to 100 feet or more.

DESCRIPTION OF WOOD

The wood is heavy, clear reddish brown, and runs from medium coarse to fine in grain. It is very durable in an unprotected state, differing greatly in this respect from wood of the Eastern Larch.

USE AND DURABILITY

It is used for structural purposes, and is especially valuable for railroad ties, as it holds spikes well, and its durability when in contact with the soil is very great. This wood is manufactured into ceiling, interior finish and moulding and when sawn vertical (edge grain) makes an excellent flooring, as the fiber of the wood wears evenly and smoothly.

Larch takes paint, oil, or stain readily, and with age ripens into a beautiful cherry color.

This lumber is widely known as "Montana Larch," and the growing demand for it is evidence of its increasing popularity with Eastern buyers.

As Western Larch is principally manufactured by Inland Mills, it cannot be **profitably** shipped in cargo lots to Foreign Countries on account of the extra cost of transportation by car to a shipping port, and the competition of other Coast woods.

NOBLE FIR

(Abies Nobilis)

Of all true firs, Noble Fir is considered the most valuable. In the deep forests which it inhabits, it is, when at its best, one of the most magnificently tall and symmetrically formed trees of its kind. The remarkably straight, even and only slightly tapering trunks are often clear of branches for 100 feet or more. Large trees are from 140 to 200 feet in height, or exceptionally somewhat taller, and from 30 to 60 inches in diameter; trees 6 to 7 feet in diameter occur, but they are rare.

RANGE

Noble Fir grows chiefly on the western slope of the Cascade Mountains, at elevations of from 2,000 to 5,000 feet, from Mount Baker in Northern Washington to the Siskiyou Mountains in Southern Oregon. It also occurs in the Olympic Mountains and in the coast ranges of Western Washington.

Though uncommon on the eastern slope of the Cascade Range, it is very abundant on the Western slope in the vicinity of the Columbia River in Oregon.

In Multnomah County, Oregon, near Bridal Veil, there are about six to eight thousand acres which are estimated to contain over 150 million board feet of Noble Fir, which is standing in a body of 15,000 acres, the balance of the stand being principally old growth Douglas Fir.

Noble Fir is abundant on Mount Rainier at elevations of 4,000 to 5,000 feet, and noted near Ashford at 3,500 feet.

COLOR AND GRAIN

The wood is of a creamy white color, irregularly marked with reddish brown areas, which adds much to its beauty. It is moderately hard, strong, firm, medium close grain, and compact. It is free from pitch, is of soft texture, but hard fiber and when dressed shows a peculiar satin sheen. In quality it is entirely different from and superior to any of the light, very soft fir woods. When seasoned this wood so closely resembles Western Hemlock that it is almost impossible to distinguish between the two when thoroughly dry.

FINISH

It is one of the best woods known for interior or exterior finish, siding, mouldings, sash and doors, and factory work for it retains its shape and "holds its place" well.

FLOORING

On account of the hard fiber, when sawn vertical (edge) grain, it makes a very satisfactory flooring, for it is close grained and presents a hard wearing surface.

GENERAL QUALITY

As the amount of surface clear cut from Noble Fir logs, generally runs from 60 to 80 per cent., the merchantable or common grades are consequently proportionately small.

The smaller trees are fine grained and sound knotted, the knots being firm and red, and interwoven with the fiber of the surrounding wood. For this reason an excellent "board" is the result, for stock boards, for barns, and other purposes where good sound common boards are wanted. This lumber holds a nail well, and produces good merchantable piece stuff such as studs, joists, planks, timbers, and ties.

In the butt cut of larger trees, the knots are often black and loose and lumber cut from this class of log produces a fine grade of "cut up" material.

The wood is odorless, tasteless and non-resinous, making boxes fit for butter, and other articles which would taint from contact with some other kind of woods.

WEIGHT

While the wet, green lumber is heavy—much heavier than Douglas Fir, it dries out so that it ships considerably lighter.

GRAND FIR—WHITE FIR

Grand Fir (Abies Grandis) is a closely allied variety of White Fir (Abies Concolas) therefore, for all practical purposes, a description of one serves for both.

WHITE FIR

(Abies Concolor)

White Fir is a massive tree and generally averages from 140 to 200 feet in height, with a diameter of 40 to 60 inches.

WEIGHT

When green the lumber is very heavy, and butt logs often sink in water. The wood naturally contains a large percentage of moisture, but after a thorough seasoning boards one inch in thickness will weigh about 2,000 pounds to 1,000 board feet.

THE WOOD

The wood is soft, straight grained and works easily. It is only used or suitable for a light class of construction work or temporary mining purposes. In color it is whitish-gray to light indistinct brown. The sawn product closely resembles Hemlock in appearance, but it is inferior to it for finish or construction. White Fir should on no account be classed or confused with Douglas Fir (Pseudotsuga Taxifolia) which botanically is not a Fir, and the wood of which is entirely different and vastly superior to that of the White Fir.

OUTPUT

More than half of the total output of White Fir is supplied by California, and approximately 10 per cent. each by Washington, Idaho and Oregon. Small quantities are produced in Montana, Colorado and other Rocky Mountain States.

ITS USE FOR PULPWOOD

Experiments conducted at the Forest Service laboratory at Washington show that this wood is admirably adapted for the production of paper pulp by the sulphite process. The wood is found to yield very readily to the action of the sulphite liquor used, which is of the usual commercial strength, viz., about 4.0 per cent total sulphur dioxide, 1.0 per cent combined and 3.0 per cent available. The length of treatment has varied in the different tests from eight to ten hours, and the steam pressure from 60 to 75 pounds. These pressures correspond to maximum temperatures of 153 to 160 degrees C.

The pulp produced in these experiments is from nearly white to light-brown in color, according to the variations in the method of cooking, and by selecting the proper conditions of treatment, it would be readily possible to produce a grade of fiber which could be used in many kinds of paper without the least bleaching. If, however, it is desired to employ the fiber for white book or writing papers, it could be readily bleached to a good white color. Results of laboratory tests show that the bleach required to bring the fiber up to the usual color for bleached sulphite spruce fiber is from 15 to 23 per cent to the weight of unbleached fiber; that is, assuming the bleaching powder to contain 35 per cent available chloride. Sulphite spruce fiber now on the market requires from 175 to 500 pounds of 35 per cent bleach per ton of product or from 9 to 24 per cent of the unbleached fiber. It is seen, therefore, that so far as bleaching is concerned, the pulp made from white fir is just as good as that made from spruce.

The yields obtained in these experiments ranged from 43 to 49 per cent on the bone-dry basis. This is exclusive of screenings, which in no case exceed 1¼ per cent of the dry wood used. From careful observation of the methods employed in determining the yields, it seems probable that those figures will be increased slightly when larger quantities of wood are used. and it is believed that in the matter of yield the Fir wood is fully equal to spruce.

The fiber from these cooks is in most cases light colored and somewhat lustrous, and the sheets formed from it without any beating are remarkably tough and strong. Microscopic examination and measurements show that the fibers are of very remarkable length, being from one-half to two-thirds as long again as the commercial sulphite spruce fiber.

It is believed from the results that, so far as the product is concerned, the manufacture of fiber from white fir would be a commercial success, and that the fiber produced would find its greatest usefulness in the production of manilas where great strength is required, and in tissues which need very long fibers. It seems probable, also, that it would make very good newspaper, for which purpose its naturally light color would particularly adapt it.

AUSTRALIAN CURRENCY WEIGHTS AND MEASURES

Currency

The currency of Australia is the same as that of Great Britain. The monetary unit is the pound sterling (£), equal to $4.8665 United States currency. One pound contains 20 shillings. One shilling (s.) equals 12 pence. or 24⅓ cents United States currency. One penny (d.) equals 2 cents United States currency.

Weights and Measures

The weights and measures of Australia with a few exceptions are the same as those in use in the United States, some of the exceptions being as follows:

1 imperial gallon	=1.2009 United States gallons.
1 ale and beer gallon	=1.2208 United States gallons.
1 proof gallon	=1.374 United States proof gallons.
1 hundredweight (cwt.)	=112 pounds avoirdupois.
1 ton	=2,240 pounds avoidupois.

DUTIES ON LUMBER

DUTIES ON LUMBER ENTERING THE COMMONWEALTH OF AUSTRALIA

	Per 100 bd. ft.
New Zealand white pine and rimu, undressed, n. e. i.	1s. 0d.
Timber, undressed, n. e. i., in sizes of 6x12 inches (or its equivalent) and over	1s. 0d.
Timber, undressed, n. e. i., in sizes of 2½x7 inches (or its equivalent) and upwards and less than 6x12 inches (or its equivalent)	3s. 0d.
Timber, undressed, n. e. i., in sizes less than 2½x7 inches (or its equivalent)	3s. 6d.
Timber, undressed, cut to sizes for making boxes	5s. 0d.
Timber, for making boxes, being cut into shape, and dressed or partly dressed	6s. 0d.
Timber, dressed, n. e. i.	4s. 0d.
Veneer, 3 ply	7s. 6d.
Veneers, n. e. i.	5s. 0d.
Timber, undressed in sizes less than 7 feet 6 inches, by 2½x10 inches, for door stock	3s. 0d.
Timber, for making doors, being cut into shape, and dressed or partly dressed	6s. 0d.

	Each
Doors of wood, including fly doors:	
Sizes 1½ inches and under	4s. 6d.
Sizes over 1½ inches and under 1¾ inches	6s. 0d.
Sizes 1¾ inches and over	8s. 6d.

	Ad valorum
Logs, not sawn	5%
Spars, in the rough	5%
Timber, bent or cut into shape, dressed or partly dressed, n. e. i.	30%
Picture and room mouldings	35%
Broom stocks, being square timber rough-sawn into sizes suitable for the manufacture of broom handles	20%
Laths, for blinds	30%

DUTIES ON LUMBER—Continued

AUSTRALIA—Continued

	Per 1000 Pcs.
Laths, n. e. i.	10s. 0d.
Palings	15s. 0d.
Shingles	5s. 0d.
	Per 100 Pcs.
Pickets, undressed	3s. 6d.
Pickets, dressed	7s. 0d.
Staves, undressed	1s. 0d.
Staves, dressed or partly dressed, but not shaped	4s. 0d.
	Per 100 Lineal Ft.
Architraves, moldings, n. e. i., and skirtings of any material	6s. 0d.

In the foregoing table the import duties are the same for the General Tariff, and Preferential Tariff on lumber the produce or manufacture of the United Kingdom. with the exception that on "Picture and room moldings." the Preferential Tariff is 30% **Ad Valorum.**

"N. e. i." means "not elsewhere included."

BERMUDA

Box material for export use, Barrels, Cooperage Stock	Free
All other wood and timber Ad Valorum	10%

BRITISH INDIA

	Ad Val.
Railway sleepers (ties)	2½%
Firewood; racks for the withering of tea-leaf; also tea-chests, made up or not	2½%
All other wood and timber	7½%

BRITISH SOUTH AFRICA

Wood. unmanufactured; ceiling and flooring boards. planed, tongued, and grooved; materials for use in construction of telegraph and telephone lines; posts, gates, hurdles. and other materials ordinarily used for agricultural or railway fencing; railway or tramway sleepers; permanent or fixed railway signals; staves, not further worked than roughly fashioned.

Under British Preferential Tariff	Free
	Ad. Val.
Under General Tariff	3%
All other wood and timber:	
Under British Preferential Tariff	12%
Under General Tariff	15%

CEYLON

Timber, not prepared; shooks and staves; empty casks; sandal and dye-woods; and other woods, unwrought	Free
Wood, imported in shooks or in any form, in which it may be used in making tea boxes, or boxes used for the despatch of samples of tea or other Ceylon products	Free
	Ad. Val.
All other wood and timber	5½%

DUTIES ON LUMBER—Continued

CHINA

		Haikwan Taels
Timber, beams, hard wood	per cubic foot	0.020
Soft wood, including Douglas fir and California redwood, on a thickness of 1 in.	per 1,000 sup. ft.	1.150
Laths	per thousand	0.210
Masts and Spars, hard wood	Ad Val.	5%
Masts and Spars, soft wood	Ad Val.	5%
Piles and Piling, including Douglas fir and California redwood, on a thickness of 1 in.	per 1,000 sup. ft.	1.150
Planks, hard wood	per cubic foot	0.020
Planks and Flooring, soft wood, including Douglas fir and California redwood, and allowing 10 per cent. of each shipment to be tongued and grooved, on a thickness of 1 in.	per 1,000 ft.	1.150
Planks and Flooring, soft wood, tongued and grooved, in excess of above 10 per cent.	Ad Val.	5%
Railway sleepers	Ad Val.	5%
Wood not otherwise specified		5%

Note:—The Haikwan (Customs) Tael is not a coin but a weight in silver, the exchange value fluctuates from 63 to 66 cents.

FIJI ISLANDS

General Tariff on Timber, August, 1916.

Class of Timber—	Ad. Val.
Timber cut for cases, not exceeding 3 feet in length	12½%
Doors and sash	12½%
Timber dressed or undressed, not over two inches wide	12½%

FRANCE

	Rates of Duty in Dollars Per 100 Pounds	
	General Tariff	Minimum Tariff
Logs, rough, not squared, with or without the bark, of any length, and of a circumference at the thick end of more than 60 cm. (23.622 inches)	.088	*.057
Wood, sawed or squared, 80 mm. (3.1496 inches) or more in thickness	.13	*.088
Wood, sawed or squared, exceeding 35 mm. (1.37795 inches) but less than 80 mm. (3.1496 inches) in thickness	.15	*.11
Wood, sawed, 35 mm. (1.37795 inches) or less in thickness	.22	*.15
Surfaced wood, planed, grooved and (or) tongued planks, strips and veneers for parquetry, planed grooved and (or) tongued:		
Of oak or other hard wood	.66	.44
Of fir or other soft wood	.46	.31
Stavewood—Means split wood which is intended exclusively for cooperage or packing purposes. The customs treatment of stave wood is also applicable to sawed staves manifestly intended for the manufacture of casks	.11	*.066
Splints:—strips and laths, cut, sawed or split of a thickness not exceeding 1 cm. (0.3937 inches)	.18	.13
Cedar, sawed, 20 cm. (7.874 inches) or less in thickness	Free	Free
Doors, windows, venetian blinds, shutters, roll shutters, roller blinds, wood paneling, and joiners work put together or not:		
Of hard wood, including articles partly of hard and partly of soft wood	2.63	1.75
Of soft wood	1.66	1.09
Painted, varnished, or lacquered in a uniform color	3.93	2.63
Carved or with raised or sunken ornaments, gilded, or with designs in imitation of the grain of the wood, or other	6.57	4.38

* Applies to imports originating in the United States or Porto Rico.

If not otherwise indicated imports originating in the United States and Porto Rico are dutiable under the general tariff.

DUTIES ON LUMBER—Continued

JAMAICA

All materials for use exclusively in the construction and equipment of railways and tramways .... Free
Wood for hoops and truss-hoops; staves and headings; shooks for tierces, puncheons, barrels, hogsheads, and casks; shooks for boxes or crates to be used in packing native agricultural produce .... Free
Pitch pine, white pine, and other lumber:
Rough or sawn, per 1,000 sup. ft. (1 in. thick) 9s
Planed, smoothed, grooved and tongued, ceiling and flooring boards; clinker or beaded boards, not otherwise manufactured, per 1,000 sup. ft. (1 in. thick) 14s
Shingles, cypress, more than 12 in. in length, per 1,000 .... 6s
Shingles, wallaba, per 1,000 .... 6s
Shingles, other .... Ad. Val. 4s

JAPAN

Wood, cut, sawn or split, simply: Pine, Douglas Fir, or Cedar:—
Cedar not exceeding 20 cm. in length, 7 cm. in width and 17 mm. in thickness .... Free
Not exceeding 65 mm. in thickness .... per cubic metre 3.10 yen
Other .... per cubic metre 1.80 yen
Wood pipe and tubes .... Ad Val. 25%
Pulp for Paper making:—
Mechanical Pulp .... per 100 kin 0.22 yen
Other .... per 100 kin 0.27 yen
The Japanese Yen equals 100 sen and is the equivalent to $0.498 U. S. money.
The Kin equals 1.32277 pounds.

NEW ZEALAND

	Gen. Tariff	Tariff on Goods from any parts of Brit. Doms.
Timber, palings, split, per 100	2s	2s
Posts, split, per 100	8s	8s
Rails, split, per 100	4s	4s
Sawn, dressed, per 100 super ft.	4s	4s
Sawn, rough, per 100 super ft.	2s	2s
Shingles and laths, per 1,000	2s	2s
Doors and sashes, either plain or glazed, with ornamental glass Ad. Val.	30%	20%
Woodenware and turnery, n. o. e. and veneers, ... Ad Val.	30%	20%

PERU

Sleepers of common wood .... Free
Masts of all kinds, unwrought .... Free
Sawn in boards, joists, beams, girders and other unenumerated shapes, per 0.023 m. in thickness:—
Pine, laurel, larch, and similar .... Free
The same, planed, tongued or grooved, or wrought in any manner, per cubic meter 14c

TRINIDAD AND TOBAGO

Articles imported specially for the furnishing, decoration, construction, and repair of churches used for public worship, on the signed declaration of the head of the denomination for which they are intended .... Free
Timber, unmanufactured:
Sawn or hewn, undressed, per 1,000 ft. 8s 4d
Sawn or hewn, wholly or partly dressed, per 1,000 ft. 12s 6d
Shingles, per 1,000 .... 1s 6d
All other wood and timber .... Ad Val. 10%

UNITED STATES

Paving posts, railroad ties, and telephone, trolley, electric light ,and telegraph poles of cedar or other woods .... Ad Val. 10%
Casks, barrels, and hogsheads (empty) sugar-box shooks and packing boxes (empty) and packing-box shooks, of wood, n. s. p., ... Ad Val. 15%
Veneers of wood .... Ad Val. 15%
Wood: Logs, timber, round unmanufactured, hewn or sawed, sided or squared; pulp woods, kindling wood, firewood, hop poles, hoop poles, fence posts, handle bolts, shingle bolts, gun blocks for gunstocks, rough hewn or sawed, or planed on one side; hubs for wheels, posts, heading bolts, stave bolts, last blocks, wagon blocks, oar blocks, heading blocks, and all like blocks, or sticks, rough hewn, sawed or bored; sawed boards, planks, deals, and other lumber, not further manufactured than sawed, planed, and tongued and grooved; clapboards, laths, pickets, palings, staves, shingles, ship timber, ship planking, broom handles, sawdust, and wood flour; all the foregoing n. s. p. .... Free
N. B.—Beaded ceiling and mouldings have been held to be free of duty.

NAUTICAL MEASURES

12 inches equals 1 foot
3 feet equals 1 yard
6 feet equals 1 fathom
3 nautical miles equals 1 league

Sea or Nautical Mile=one-sixtieth of a degree of latitude, and varies from 6,046 ft. on the Equator to 6,092 ft. in lat. 60°.
Nautical Mile for speed trials, generally called the Admiralty Measured Mile = 6,080 feet; 1.151 statute miles; 1,853 meters.
Cable's length = the tenth of a nautical mile; or approximately, 100 fathoms or 200 yards.
A Knot = a nautical mile an hour, is a measure of speed, but is not infrequently, though erroneously, used as synonymous with a nautical mile.

Length of European Measures of Distances compared with the Nautical Mile of 6,080 feet:

	Length in Nautical Miles
Nautical Mile	1.000
British Statute Land Mile	0.868
Austrian Mile	4.094
Danish Mile	4.064
French Kilometer	0.539
German Geographical Mile	4.000
German Ruthen	4.064
Italian Mile	1.000
Norwegian Mile	6.097
Russian Verst	0.576
Swedish Mile	5.769

WATER MEASURE

Weight of Fresh Water

1	cubic inch .03617 pound.
12	cubic inches .434 pound.
1	cubic foot 62.5 pounds.
1	cubic foot 7.48052 U. S. gallons.
1.8	cubic feet 112.0 pounds.
35.84	cubic feet 2240.0 pounds.
1	cylindrical inch .02842 pound.
12	cylindrical inches .341 pound.
1	cylindrical foot 49.10 pounds.
1	cylindrical foot 6.0 U. S. gallons.
2.282	cylindrical feet 112.0 pounds.
45.64	cylindrical feet 2240.0 pounds.
1	imperial gallon 10.0 pounds.
11.2	imperial gallons 112.0 pounds.
224	imperial gallons 2240.0 pounds.
1	U. S. gallon 8.355 pounds.
13.44	U. S. gallons 112.0 pounds.
268.8	U. S. gallons 2240.0 pounds.

NOTE—The centre of pressure of water against the side of the containing vessel or reservoir is at two-thirds the depth from the surface.

WEIGHT OF SALT WATER
At 62° Fahrenheit

1 cubic inch 259 grs.
1 cubic foot 64.11 pounds.
1 imperial gallon 10.27 pounds.
1 U. S. gallon 8.558 pounds.
1 long ton (2240 pounds) 35 cubic feet.
1 long ton (2240 pounds) 218.11 imperial gallons.
1 long ton (2240 pounds) 240 U. S. gallons.
1 short ton (2000 pounds) 31.2 cubic feet.
1 short ton (2000 pounds) 194.74 imperial gallons.
1 short ton (2000 pounds) 233.7 U. S. gallons.

DENSITY OF WATER AND COAL CONSUMPTION

When figuring on a vessel's draft allowance must be made for density of water; that is, the difference in weight between fresh and salt water, also consumption of coal on inland waters. The usual method employed is to add to draft at load line one or two inches according to circumstances.

IMMERSION IN SALT AND FRESH WATER

To find the difference of immersion or draft in salt and fresh water: If from salt to fresh, multiply the draft of salt water by 36, and divide the product by 35. If from fresh to salt, multiply the draft of fresh water by 35 and divide the product by 36.

Example:
Required the draft of a vessel in fresh water when drawing 20 ft. in salt water:
20 ft. × 36 = 720 ÷ 35 = 20 ft. 7 in.

BARRELS

To find the number of gallons in a cask or barrel.

Rule:

Take all the dimensions in inches. Add the head and bung diameters and divide by 2 for the approximate mean diameter. Square the mean diameter and multiply by the depth. Multiply the result by .0034 for gallons.

Example:

How many gallons are contained in a cask the bung diameter of which is 24 inches, the head diameter, 22 inches, and the depth 30 inches?

Operation:

$22+24=46\div 2=23$ (mean diameter). Square of $23=529\times 30$ (depth)$=15870$. $15870\times .0034=53.9$ gallons.

MEASURING TANKS

To find the number of gallons contained in a tank.

Rule:

Multiply the cubic capacity in feet by 7.48.

Example:

How many gallons in a tank 6x6x4 feet?

Explanation:

$6\times 3\times 4=72$ cubic feet. $7.48\times 72=538.56$ gallons. $538.56\div 31\frac{1}{2}=17.10$—. bbl.

CISTERNS

To find the capacity of a cistern.

Rule:

Multiply the square of the diameter by the depth; this will give the cylindrical feet; multiply the cylindrical feet by $5\frac{7}{8}$ for gallons; .1865 for barrels, or .09325 for hogsheads.

Example:

How many gallons in a cistern 42 feet in diameter, 12 feet deep?

Operation:

$42\times 42=1764$; $1764\times 12=21168$; $5\frac{7}{8}\times 21168=124362$ gallons=Answer.
How many barrels?—Answer, 394.8.

EXPLANATION OF TONNAGE AND DISPLACEMENT

Many different tonnage units are employed in the overseas export trade. Tonnage is of two general kinds: cargo tonnage, which expresses the quantity of cargo being shipped, and vessel tonnage, which expresses the size or capacity of the ship.

CARGO TONNAGE

Cargo tonnage may be stated in four ways: (1) Long tons of 2,240 pounds each, (2) metric tons of 2,204 pounds, (3) short tons of 2,000 pounds, or (4) measurement tons—usually of 40 cubic feet. Long tons and measurement tons are most commonly used in the overseas export trade of the United States, the former usually in connection with cargoes shipped in terms of their weight, and the latter in connection with light freight or general cargoes which are frequently shipped on the basis of the space which they occupy.

VESSEL TONNAGE

Vessel tonnage is expressed in four ways: (1) Displacement tonnage, (2) deadweight tonnage, (3) gross tonnage, (4) net tonnage. Displacement tonnage indicates the weight of the vessel or of the water displaced by it and in the United States is expressed in terms of the avoirdupois ton of 2,240 pounds. It may be either "light displacement," which represents the vessel's weight when its crew and supplies are on board, but before any fuel, cargo or passengers have been loaded; or, it may be "maximum" or "full load displacement," which represents the vessel's weight when fully loaded to its deep load line.

DEADWEIGHT TONNAGE

A vessel's deadweight tonnage represents the maximum weight of cargo and fuel which it is able to carry when loaded to its deep load line. It is the difference between its light and maximum displacement tonnage, and is, in case of the United States, usually expressed in terms of the long ton.

GROSS TONNAGE

The gross register tonnage of a vessel is its total inclosed content expressed in tons of 100 cubic feet, as ascertained by the measurement authorities of the vessel's home country.

NET TONNAGE

A vessel's net tonnage, theoretically, should represent the cubical contents of the space available for cargoes and passengers expressed in tons of 100 cubic feet. In practice, however, it understates the real net capacity of a vessel and varies according to the particular national measurement rules which are applied. Net tonnage is ascertained by making certain deductions from the vessel's gross tonnage as prescribed by the measurement rules of various countries.

DOUGLAS FIR SHIPMENTS

POINTERS FOR SHIPOWNERS ON LUMBER CARRYING CAPACITY OF STEAMERS

When figuring on the lumber carrying capacity of steamers, allowance must be made for bunker coal, stores, provisions, boiler and feed water, water ballast, type of vessel, and height of deckload she will safely carry, also proportion of sizes and lengths in the lumber specifications suitable for stowage on deck and in the various compartments under deck, the number of timbers to be carried, and whether short lumber, pickets and or lath will be supplied for broken stowage.

In a large number of instances specifications contain every requisite for making good stowage, but it is of no avail if the lengths and sizes are not piled on the dock prior to shipment so as to be available at the right time and place to fill the various compartments.

If the lumber for shipment is not placed on the dock right, poor stowage and a great decrease in the amount of cargo the vessel should carry will be the result and the time of loading will often be increased several days.

Poor stowage under deck results in vessel becoming top heavy, and consequently the usual height of deckload cannot be carried, as extra ballast tanks have to be filled to stiffen vessel and keep her upright.

This seriously affects the cargo carrying capacity of a vessel; for instance, filling a ballast tank of 300 tons would decrease the amount of cargo carried by 200,000 board feet of lumber.

When a steamer lists before she has a reasonable deckload, the cause should be investigated. There are instances where the fuel for main or donkey boilers is taken from one side of the upper portion of bunkers, emptying or filling a boiler, feeding water in boilers from one side of an engine tank with a central division, filling or emptying ballast tanks, or slack water in ballast tanks; the latter being the principal cause.

TO COMPUTE LUMBER CARRYING CAPACITY UNDER DECK

To compute lumber carrying capacity of a steamer, ascertain from the builder's plan the cubical capacity (bale space) of the various compartments, add together and multiply the total by $8\frac{1}{3}$; the result will be the capacity in board feet.

Example:

How much lumber in board feet will a steamer carry under deck with a total cargo carrying capacity of 300,000 cubic feet (bale space)°

Operation:

$300{,}000 \times 8\frac{1}{3} = 2{,}500{,}000$, the amount in board feet.

Note:

To multiply by $8\frac{1}{3}$ add two ciphers and divide by 12.

TO COMPUTE DEADWEIGHT LUMBER CARRYING CAPACITY OF A STEAMER

To ascertain the deadweight lumber carrying capacity of a steamer, the following particulars should be obtained:

Distance between sailing and discharging port.

Speed of vessel, and daily coal consumption.

Weight of ship's stores and provisions.

Estimate of water ballast required.

Bunker coal necessary for voyage.

The first thing to do is to find out from the builder's plan, owners or officers of vessel, the speed in knots per hour and daily coal consumption; then compute the bunker coal required for the voyage as follows:

Example:
How much bunker coal will a steamer consume on a voyage from Seattle, Wash., U. S. A., to Sydney, N. S. W., Australia, the distance being 6829 nautical miles, speed 8 knots (nautical miles) per hour, and the daily consumption 29 tons of coal?

Multiply the knots (8) by 24; this gives the distance traveled per day. Then divide the result (192) into the distance between loading and discharging port. In this case it is 6829 nautical miles; the answer will be the number of days occupied on voyage. Now multiply the number of days by the coal consumption (29) and you will have the bunker coal required for the voyage.

Operation:

$8 \times 24 = 192$, the daily speed. $6829 \div 192 = 35.57$, the number of days on voyage. $35.57 \times 29 = 1031.53$, the amount of bunker coal in tons required for the voyage.

Note:

It is customary to allow a few days reserve coal so that if steamer meets with an accident or bad weather the extra coal should enable her to reach port in safety. In this case an allowance of three days reserve coal should suffice.

METHOD OF ESTIMATING DEADWEIGHT TOTALS BEFORE OR AFTER LOADING

Capacity of vessel 7200 tons deadweight.

	Tons
Bunker coal	1031
Bunker coal, reserve	87
Water ballast	400
Engine tank, fresh water	182
Stores and provisions	75
Fresh drinking water	25
	1800
3,600,000 ft. @ 1½ tons per 1000 ft.	5400
	7200

The ordinary tramp steamer with coal for bunker fuel will not stand up with a high deckload without water ballast, therefore in the foregoing estimate a fair allowance has been made.

TO COMPUTE LUMBER CARRYING CAPACITY OF A STEAMER ON DECK

This is practically impossible, as so much depends on the stowage of cargo under deck, and also the height at which the bunker coal is stowed, whether it is winter or summer loading, the type and beam of vessel and amount of water ballast required.

When estimating on the amount of deckload always take the possible height into consideration, and remember that a steamer cannot carry more than her deadweight according to displacement scale.

The trick in loading steamers with lumber is to load them with the minimum of water ballast, and that can only be done by having an expert supervise the assembling or piling of the cargo beforehand, and taking advantage of every point during loading. This will greatly assist the stevedore, the mill company and ship's officers, and be of immense benefit to all concerned.

NEWSPRINT PAPER

CARGO SHIPMENTS OF PAPER IN CONJUNCTION WITH DOUGLAS FIR AND REDWOOD

As the shipment of print paper in rolls from British Columbia and the Pacific ports of the United States to Australia, New Zealand and other countries will supplant this trade which formerly was held by Germany, the following information will be of considerable assistance to those interested in this particular line.

The ordinary tramp steamer of about 7000 tons deadweight can carry a full cargo of paper under deck, with Redwood doorstock and / or dry lath or pickets for stowage, also a deckload of lumber equal in capacity and height to the amount that the steamer would ordinarily carry with a straight cargo of Douglas Fir, provided that good stowage is made both under and on deck.

DIMENSIONS OF PAPER ROLLS

Paper rolls vary according to orders of foreign buyers, though they usually run from 21¼ inches to 84 inches in height, with a preponderance of 39-inch rolls. The diameter of rolls vary, but 34 to 36 inches could be considered a fair average. The height of roll is the net size (the width of paper) and an allowance of three inches extra in height should be made for wrapping paper.

In some cases the ends of rolls are wooded, which means that the top and / or bottom ends are protected by boards about three-quarters of an inch in thickness and shaped to conform to the circular area of the end of the roll. The length and gross weight in pounds is stencilled on the side of each roll.

Rolls about 21 inches in height are called cheese rolls at point of shipment. This is on account of their resembling a roll of cheese.

These rolls are a very valuable aid to stowage. They can be used on their bilge or flat side to great advantage in the wings, between the top course of paper and beams, or any place where a larger roll would not go.

The following is an original specification of a shipment of paper rolls for Sydney, Australia, which gives a very fair idea of the dimensions and weight of the average paper roll:

SPECIFICATIONS GIVING DIMENSIONS AND WEIGHT OF NEWSPAPER ROLLS FOR FOREIGN SHIPMENT

Number of Rolls	Height Inches	Diam. Inches	Average Weight in Pounds	Gross Wetight in Pounds	Tare Weight in Pounds	Net Weight in Pounds
641	39	34	710	454,972	13,621	441,351
180	35	34	650	117,107	3,600	113,507
600	39	34	650	390,348	12,750	377,598
1,844	84	36	1,700	3,126,236	95,888	3,030,348
1,827	42	36	836	1,526,682	39,280	1,487,402
1,023	21¼	36	435	445,386	14,322	431,064
6,115				6,060,731	179,461	5,881,270

HOW TO DUNNAGE AND STOW PAPER ROLLS IN A SHIP'S HOLD

Stanchions, pillars, frames or any section of compartment composed of steel or iron should be covered with burlap or otherwise dunnaged so as to prevent paper from being damaged through coming in contact with or chafing against the steel or iron parts mentioned.

Before loading, the floors of the various holds should be dunnaged with lumber to prevent damage and levelled to make a solid foundation for the paper rolls. The after holds and especially the aftermost hold where the rise of the floor is very acute, should be filled with cargo other than paper if available to about the top of the shaft tunnel.

Paper rolls must be stowed on end on a practically level floor; if stowed on bilge (side) they would be crushed out of shape by the upper courses and rendered useless for the purpose for which they are intended as they would not then revolve evenly on the newspaper machine cylinder.

Cargo hooks must not be used to handle paper rolls, and extreme care must be used to guard against the rolls striking against side of vessel, hatch coamings or other obstructions during process of loading.

If order of loading permits, the longest rolls should be stowed first in the hold; then the next to the longest length in rotation, reserving the shorter rolls to be used where a long roll cannot be stowed.

NEWSPRINT PAPER—Continued

SHORT STOWAGE REQUIRED

Short stowage which must be dry is required to fill spaces between paper rolls; also in wings (sides), against iron bulkheads and in vacant spaces between the top course of rolls and beams of vessel.

One hundred thousand board feet of dry doorstock, box shooks, dry lath or dry pickets is required to stow one thousand gross long tons of paper.

If lumber or stowage is loaded on steamer prior to taking paper cargo, it should be stowed in one end of each compartment only, preferably the narrow end.

If spread over the entire floor space it would have to be rehandled and thus delay the work of loading. When stowed in one end of a compartment, work of loading can commence in the vacant end immediately vessel arrives at paper mill, and the stowage in the other end can be used when required without retarding the work.

It is a cardinal rule never to use a short roll except for an emergency, as they are easily handled and if they are not all utilized during loading they will come in very handy to finish off with.

CUBIC STOWAGE PER TON OF PAPER ROLLS

Under favorable conditions such as a vessel with large compartments or when the orders contain a large quantity of medium sized rolls or of a length that will stow from floor to beams without loss of space, about ninety-one cubic feet bale space should be allowed for one gross long ton of paper.

When there is a great variety of sizes, or the lengths are such that good stowage cannot be made owing to build of vessel or for any reason that results in a loss of space between the upper course and beams an allowance of at least ninety-five cubic feet bale space should be made.

BUNKER SPACE

All available space under deck should be reserved for cargo, and only enough bunker capacity allowed to cover the run on the longest leg of the voyage. For instance, a steamer from British Columbia or the U. S. North Pacific Coast, with a cargo destined for Sydney, Australia, should not take coal for the entire voyage, but should replenish her bunkers at Honolulu, Hawaii, taking sufficient coal there to safely carry her to Sydney.

By referring to the following distances the benefit of replenishing bunkers at Honolulu will be apparent:

Distance from Victoria, B. C., to Honolulu, 2349 nautical miles.

Distance from Port Townsend, Wash., to Honolulu, 2366 nautical miles.

Distance from Honolulu to Sydney, Australia, 4420 nautical miles.

A vessel making nine knots per hour on a daily consumption of 28 tons of coal would be 20½ days on the voyage from Honolulu to Sydney, and would require a minimum of 574 tons of coal. To this amount should be added about four days' extra supply of coal or 112 tons as a reserve against accident or bad weather.

STABILITY

Contrary to a general supposition a steamer with a full cargo of paper under deck, and broken spaces well filled with short stowage, and a full and complete deckload of about 800,000 board feet of Douglas Fir and averaging about eleven feet in height, will stand up as well at the finish as if the entire cargo was Douglas Fir.

The reason for this is, that with a paper cargo under deck all bottom ballast tanks would be full, and with a straight cargo of Douglas Fir about half of the bottom ballast tanks of a capacity of say 600 tons would be empty. Therefore the extra weight of ballast required for a paper cargo would be in the bottom of the vessel and offset the heavier weight of Douglas Fir at a higher elevation in the hold.

DEADWEIGHT

The ordinary tramp steamer loaded under foregoing conditions would probably be six to ten inches off her summer marks with all bottom ballast tanks full.

Therefore if it is possible to obtain as cargo about 500 tons deadweight of iron, lead, steel, tin, canned salmon or any commodity of a specific gravity several times heavier than water that can safely be stowed in bottom of vessel it would be an aid to stability and add to freight profits by replacing a large portion of water ballast with profitable cargo.

POINTERS ON FILLING BALLAST TANKS

In loading steamer with a combination of paper and lumber it is good policy to regulate the weight of cargo and stowage in such a manner that the vessel can be loaded to her marks with one or more small double bottom ballast tanks empty, so that in event of vessel becoming tender towards the end of the voyage, through burning the coal stowed in the lower part of bunkers, the bottom tanks could be filled and the steamer would retain her stability by substituting the water ballast for coal.

If possible leave tanks of small capacity empty, as they are only filled during voyage in case of emergency, it being considered a hazardous undertaking for a steamer with a high deckload to fill a large tank at sea, as the rolling of vessel would cause the slack water to rush to one side of the tank which would probably result in the steamer taking a very dangerous list.

CONVERSION OF U. S. AND ENGLISH MONEY

According to Act of Congress, March 8, 1873, the Pound Sterling of Great Britain equals \$4.8665; the value of one shilling equals \$0.24 ⅓; the value of one penny equals \$0.02.

Table of Sterling Money

4 Farthings (far) equal 1 penny (d.).
12 Pence equal 1 shilling (s.).
20 Shillings equal 1 pound (£).

A Simple Process to Change Pounds, Shillings and Pence to Dollars and Cents

Reduce pounds to shillings, add in the shillings, if any, and multiply the sum by .24⅓; if any pence are given, increase the product by TWICE as many cents.

Reduce £185, 17s. and 9d. to U. S. money:

185×20=3700
17

Shillings, 3717
3717×.24⅓=904.47
+9d.= .18

Ans. \$904.65

Another Simple Method to Reduce Pounds to Dollars, and Vice Versa Exchange Being at \$4.8665

Multiply the number of pounds by 73, and divide the product by 15; the result will express its equivalent in dollars and cents. Or,

Multiply dollars by 15 and dividing the product by 73, will give its equivalent in Pounds and decimals of a Pound.

How many dollars in £96?
£96×73/15=\$467.20. Ans.

How many pounds in \$839.50?
\$839.50×15/73=£172.5. Ans.

TO COMPUTE LUMBER SHIPMENTS IN POUNDS, SHILLINGS AND PENCE

In making up Bills of Lading for British countries, the rate per thousand is invariably figured in English mnoey. The following method explains the usual way of computing the freight in pounds, shillings and pence.

Example No. 1:
What will the total freight amount to in sterling money on a shipment of lumber containing 220,024 board feet at £3 10s. 0d. per thousand.

Operation:
220,024 × £3½ (£3 10s.) equals £770.084
20

Shillings 1.680
12

Pence 8.160

Answer: £770 1s. 8d.

Explanation:

As the rate of freight is per thousand feet, point off three figures and multiply by £3½, which is the equivalent of £3 10s. 0d. This gives £770 and decimal .084 of a pound. Multiply .084 by 20 to obtain the shillings and .680 by 12 to obtain the pence.

TO COMPUTE LUMBER SHIPMENTS—Continued

Example No. 2:

What will the total freight amount to in sterling money on a shipment of lumber containing 86,976 board feet at £2 6s. 9d. per thousand?

In this instance it is advisable to bring the pounds and shillings to pence, which in this case amounts to 561 pence.

Operation:

86.976 Board Feet
561 Pence

86976
521856
434880

12)48793.536

20)4066.128 (Multiply .128 by 12 to obtain the pence which is 1.536 or 1½d.)

203.6

Answer: £203 6s. 1½d.

Explanation:

As the rate of freight is per thousand, point off three figures and multiply by 561 (the pence). Divide the product by 12 which gives 4066 shillings and decimal point 128 of a shilling. Now divide 4066 shillings by 20, to obtain the pounds. This gives 203 pounds and six shillings. To obtain the pence multiply .128 by 12; this gives 1.536 or 1½ pence.

TO MAKE A WATCH ANSWER FOR A COMPASS

If the watch is on time, turn it around so that the hour hand will point to the sun. Then just mid-way between where the hour hand points on the dial and 12 o'clock on the dial, is SOUTH.

It is of no consequence what time of day, or what time of year it is—the rule applies at all times any place north of the equator.

Absolute exactness is not claimed for this rule, but it is always near enough for practical purposes.

Note—Pay no attention to the minute hand.

LONGITUDE AND TIME

Since the earth revolves around its axis in 24 hours, and its circumference is divided into 360 degrees, the sun apparently passes over 15 degrees in 1 hour ($360 \div 24 = 15$); and consequently over 1 degree in 4 minutes ($60 \div 15 = 4$). Hence, these simple Rules:

Rule—Multiplying the Longitude, expressed in degrees, by 4 gives the equivalent Time expressed in minutes.

Rule—Dividing the Time, expressed in minutes, by 4 gives the equivalent Longitude expressed in degrees.

The difference in Longitude between Boston and San Francisco is nearly 51¼ degrees; what is the difference in Time?

Answer—$51\frac{1}{4} \times 4 = 205$ min., or 3 h. 25 min.

The difference in Time between London and New York is nearly 4 h. and 51½ min.; what is the difference in Longitude?

Answer—4 h. 55½ min.=295½ min. $295\frac{1}{2} \div 4 = 73\frac{7}{8}$ deg.

Notes—A degree of Longitude at the equator is 69.16 miles; at ten degrees of Latitude, 68 miles; at twenty degrees, 65 miles; at thirty degrees, 60 miles; at forty degrees, 53 miles; at fifty degrees, 44.5 miles; at sixty degrees, 34.6 miles, etc. Thus longitude gradually diminishes with each degree of latitude, till at the poles it runs to nothing, as all the meridians converge from the equator to a point at the poles.

The degrees of Latitude run parallel, and would be equally distant apart were the earth a perfect sphere, but owing to its polar diameter being 26½ miles shorter than its equatorial diameter, the first degree being 68.8 miles; th forty-fifth, 69 miles, and the ninetieth, 69.4 miles.

The earth's equatorial diameter is 7925.6 miles. Its polar diameter, 7899.1 miles.

BENEFIT OF TABLE OF DISTANCES AND DIFFERENCE IN TIME TABLE

The table of distances and difference in time table included in this work will prove a valuable aid to shipowners and lumbermen engaged in the export cargo trade, as it will enable them to quickly arrive at the distance between loading and discharging ports, and the time that vessel would be due to arrive at destination.

Steamers on long voyages do not always go direct to destination, but invariably stop at one or more coaling ports for bunkers.

The distances in this book are arranged with this object in view, thereby enabling the reader to ascertain the distance from the principal ports of the world to any Douglas Fir or Redwood cargo mill on the Pacific Coast.

Vessels destined for British Columbia ports usually stop first at Victoria, Vancouver Island; for Puget Sound ports at Port Townsend, Wash.; for Portland and Columbia River ports at Astoria, Ore. This stop is made for any of the following reasons: To call for orders, pass quarantine, fumigate, enter, or take a local pilot if proceeding to inland waters.

To ascertain the distance between ports it is often necessary to refer to one or more route ports. As an illustration, presume you wish to find the distance from Seattle, Wash., to Liverpool, England, you would trace the distance by following the nearest navigable route, which is as follows:

Seattle, Wash., to Port Townsend	39 Nautical Miles
Port Townsend to Panama, C. Z.	3985 Nautical Miles
Panama, C. Z., to Colon, C. Z.	43 Nautical Miles
Colon, C. Z., to Liverpool, via Mona Passage	4548 Nautical Miles
Total distance	8615 Nautical Miles

To trace the distance to the Mediterranean Sea ports, such as Barcelona, Spain; Marseilles, France; Genoa and Naples, Italy, and Alexandria and Port Said, Egypt, use the following route ports: Panama, Colon and Gibraltar.

LENGTH OF PANAMA CANAL

The distance from Panama Roads, Canal Zone, to Colon, Canal Zone, is 43 nautical ,or 50 statute, miles.

TO COMPUTE TIME OCCUPIED ON VOYAGE

To compute the number of days that a full powered steamer would occupy on a voyage, the following data is necessary.

Difference in time between port of departure and port of destination. Distance between ports, and the speed of steamer in knots (nautical miles) per hour.

Example:

A steamer averaging 10 knots per hour leaves Sydney, New South Wales, Eastern Australia, at 6 a. m., January 2nd (Australian time), bound for Portland, Oregon. When is she due at destination?

Process:

By referring to the "Difference in Time Table," you will note the difference in time between Eastern Australia and the U. S. Pacific Coast is 18 hours. Therefore the first thing to do is to adjust the Australian time to correspond to that of the U. S. Pacific Coast, which in this case will be noon, January 1st. The number of nautical miles from port to port is found by reference to the Honolulu "Distance Table," which gives the distance to both Sydney and Portland, the total being 6,752 nautical miles.

The number of knots per hour (10) is multiplied by (24) the hours per day, which equals 240 knots, or nautical miles, and is divided into 6752, the number of nautical miles covered by steamer on voyage, which gives 28.133 days, or the equivalent of 23 days 3 hours.

This is added to the Pacific Coast time of steamer's departure from Sydney, making January 29th three p. m. as the time vessel is due at Portland, Oregon, without allowing for stoppages.

Note:

It is customary for a steamer destined for Portland, Oregon, to proceed to the entrance of the Columbia River, and there pick up a bar pilot, who takes the vessel to Astoria.

The services of the bar pilot are dispensed with at Astoria, where a Columbia River pilot is engaged to take the vessel to Portland.

DIFFERENCE IN TIME TABLE

When it is noon today from Vancouver, B. C., to San Diego, California:

In Washington and Boston	it is	3:00 p.m. today
In New York and Philadelphia	it is	3:00 p.m. today
In Chicago, St. Louis and New Orleans	it is	2:00 p.m. today
In Cheyenne and Denver	it is	1:00 p.m. today
In Sitka, Alaska	it is	11:00 a.m. today
In Porto Rico	it is	4:00 p.m. today
In Panama Canal Zone	it is	3:00 p.m. today
In Honolulu, Hawaiian Islands	it is	9:30 a.m. today
In Tutuila, Samoa	it is	8:30 a.m. tomorrow
In Guam Islands	it is	5:30 a.m. tomorrow
In Manila, Philippine Islands	it is	4:00 a.m. tomorrow
In Argentine	it is	3:43 a.m. tomorrow
In Australia, Western	it is	4:00 a.m. tomorrow
In Australia, Central	it is	5:30 a.m. tomorrow
In Australia, Eastern	it is	6:00 a.m. tomorrow
In Austria-Hungary	it is	9:00 p.m. today
In Belgium	it is	8:00 p.m. today
In Borneo (British North) and Labuan	it is	4:00 a.m. tomorrow
In Brazil (Rio de Janeiro)	it is	5:00 p.m. today
In Chile	it is	3:30 p.m. today
In China (Hongkong)	it is	4:00 a.m. tomorrow
In China (Saigon)	it is	3:00 a.m. tomorrow
In Colombia (Bogota)	it is	3:00 p.m. today
In Costa Rica	it is	3:00 p.m. today
In Cuba	it is	3:30 p.m. today
In Denmark	it is	9:00 p.m. today
In Ecuador	it is	2:45 p.m. today
In Egypt	it is	10:00 p.m. today
In England	it is	8:00 p.m. today
In Fiji Islands (Suva)	it is	8:00 a.m. tomorrow
In France	it is	8:00 p.m. today
In Germany	it is	9:00 p.m. today
In Gibraltar	it is	8:00 p.m. today
In Greece	it is	9:30 p.m. today
In Holland	it is	8:00 p.m. today
In Honduras	it is	2:00 p.m. today
In India (Madras)	it is	1:30 a.m. tomorrow
In Ireland	it is	7:30 p.m. today
In Italy	it is	9:00 p.m. today
In Jamaica (Kingston)	it is	3:00 p.m. today
In Japan	it is	5:00 a.m. tomorrow
In Java	it is	3:00 a.m. tomorrow
In Korea	it is	5:00 a.m. tomorrow
In Madagascar (Tananarivo)	it is	11:00 p.m. today
In Malta	it is	9:00 p.m. today
In Mauritius	it is	midnight tonight
In Mexico	it is	1:30 p.m. today
In Newfoundland	it is	4:30 p.m. today
In New Zealand	it is	7:30 a.m. tomorrow
In Nicaragua	it is	2:15 p.m. today
In Nome, Dutch Harbor	it is	9:00 a.m. today
In Norway	it is	9:00 p.m. today
In Peru	it is	3:00 p.m. today
In Portugal	it is	7:30 p.m. today
In Russia (Irkutsk)	it is	3:00 a.m. tomorrow
In Russia (Pulkova)	it is	10:00 p.m. today
In Russia (Vladivostok)	it is	5:00 a.m. tomorrow
In Singapore	it is	3:00 a.m. tomorrow
In Spain	it is	8:00 p.m. today
In Sweden	it is	9:00 p.m. today
In Switzerland	it is	9:00 p.m. today
In Tunis	it is	8:00 p.m. today
In Turkey	it is	10:00 p.m. today
In Uruguay	it is	4:15 p.m. today
In Valdez, Fairbanks, Tanana	it is	10:00 a.m. today
In Venezuela	it is	3:30 p.m. today

Courtesy of "North Pacific Ports"

INLAND WATERS

PUGET SOUND, WASHINGTON AND BRITISH COLUMBIA PORTS

Nautical Miles

From undermentioned ports to	Bellingham	Cape Flattery	Comox, B. C.	Dupont	Everett	Nanaimo, B. C.	Port Angeles	Port Blakeley	Port Gamble
Anacortes	15	96	126	107	62	75	43	67	45
Bellingham	...	111	130	122	77	60	58	82	59
Blaine	36	110	105	132	88	54	62	93	75
Bremerton	84	129	194	39	35	127	73	10	39
Cape Flattery	111	...	190	155	117	141	56	121	102
Comox, B. C.	130	190	...	208	170	53	143	175	157
Dungeness	44	72	136	84	46	88	15	51	33
Departure Bay	75	141	52	165	127	7	91	132	115
Dupont	122	155	208	...	56	165	98	35	59
Everett	77	117	170	56	...	127	60	28	24
Esquimalt, B. C.	50	59	132	102	64	90	19	69	50
Friday Harbor	38	80	110	95	57	65	42	62	44
James Island	52	78	114	105	67	70	36	72	54
Mukilteo	73	113	165	52	4	120	53	23	22
Nanaimo, B. C.	60	141	53	165	127	...	94	132	114
Neah Bay	97	7	183	148	110	134	50	115	97
Olympia	133	168	221	16	76	178	111	49	82
Port Angeles	58	56	143	98	60	94	...	65	47
Point Atkinson	64	133	74	159	121	28	88	126	108
Port Blakeley	82	121	175	35	28	132	65	...	30
Port Crescent	63	44	146	108	71	88	12	76	58
Port Gamble	59	102	157	59	24	114	47	30	...
Port Ludlow	53	98	153	56	22	110	43	26	6
Point No Point	59	103	156	50	14	113	46	19	11
Port Townsend	42	89	141	69	31	97	30	36	17
Point Wilson	39	85	138	70	32	95	28	37	19
Powell River, B. C.	118	180	20	210	172	50	138	171	159
Seattle	81	123	179	34	28	134	69	7	33
Steilacoom	114	160	206	5	52	162	98	30	61
Tacoma	100	144	196	20	46	153	87	25	51
Union Bay, B. C.	125	185	5	203	165	54	140	170	152
Vancouver, B. C.	70	140	27	165	128	35	94	132	114
Victoria, B. C.	43	59	129	100	62	84	18	67	50
Possession Point	62	108	159	53	8	116	49	19	16

INLAND WATERS

PUGET SOUND, WASHINGTON, AND BRITISH COLUMBIA PORTS

Nautical Miles

From undermentioned ports to—	Port Ludlow	Port Townsend	Powell River, B. C.	Seattle	Tacoma	Union Bay, B. C.	Vancouver, B. C.	Victoria, B. C.
Anacortes	45	30	116	69	88	121	68	31
Bellingham	53	42	118	81	100	125	70	43
Blaine	69	58	98	94	114	100	49	53
Bremerton	36	44	184	13	25	190	139	74
Cape Flattery	98	89	180	123	144	185	140	59
Comox, B. C.	153	141	20	179	196	5	27	129
Dungeness	28	17	130	53	72	131	80	19
Departure Bay	109	98	48	135	150	45	34	82
Dupont	56	69	210	34	20	203	165	100
Everett	22	31	172	28	46	165	128	62
Esquimalt, B. C.	43	33	129	71	89	128	86	4
Friday Harbor	37	28	106	65	83	106	57	30
James Island	50	37	112	72	93	115	67	23
Mukilteo	18	24	167	25	43	160	120	55
Nanaimo, B. C.	110	97	50	134	153	54	35	84
Neah Bay	93	80	177	117	136	179	129	49
Olympia	78	81	223	50	24	216	178	115
Port Angeles	43	30	138	69	87	140	94	18
Point Atkinson	104	92	66	128	148	69	7	76
Port Blakeley	26	36	171	7	25	170	132	67
Port Crescent	54	41	143	78	97	148	106	19
Port Gamble	6	17	159	33	51	152	114	50
Port Ludlow	...	14	155	31	50	148	111	46
Port Townsend	14	...	143	39	58	136	97	31
Point Wilson	16	3	140	40	60	133	95	30
Powell River, B. C.	155	143	...	180	198	24	73	126
Seattle	31	39	180	...	24	173	135	68
Steilacoom	60	69	208	35	16	201	130	98
Tacoma	50	58	198	24	...	191	155	68
Union Bay, B. C.	148	136	24	173	191	...	77	125
Vancouver, B. C.	111	97	73	135	155	77	...	84
Victoria, B. C.	46	31	126	68	68	125	84	...
Possession Point	13	20	160	19	39	154	116	52

	Nautical Miles
Ocean Falls, Vancouver Island, B. C., to Port Townsend	372
Ocean Falls, Vancouver Island, B. C., to Seattle, Wash.	410
Port Alberni, Vancouver Island, B. C., to Victoria, B. C.	130

TABLE OF DISTANCES

ACAPULCO

Acapulco, Mexico, to— Route—	Nautical Miles
Antofagasta, Chile	2.984
Arica, Chile	2,768
Caldera, Chile	3,130
Callao, Peru	2,198
Coquimbo, Chile	3,259
Corinto, Nicaragua	792
Esmeraldas, Ecuador	1,527
Guayaquil, Ecuador	1,708
Honolulu, Hawaii	3,289
Iquique, Chile	2,834
Lota, Chile	3,573
Magdalena Bay, Mexico	853
Mollendo, Peru	2,643
Pacasmayo, Peru	1,895
Paita, Peru	1,725
Panama, C. Z.	1,426
Pichilinque Harbor (U. S. coal depot) Mexico.	778
Pisco, Peru	2,309
Punta Arenas, Chile	4,582
Punta Arenas, Costa Rica	1:011
Salina Cruz, Mexico	314
San Jose, Guatemala	574
Tahiti (Papeete), Society Is.	3,595
Talcahuano, Chile	3,558
Valdivia (Port Corral), Chile	3,712
Valparaiso, Chile	3.406

ASTORIA

Astoria to—	Nautical Miles
Columbia River Bar	10
Dutch Harbor, Alaska	1688
Grays Harbor Bar	53
Port Townsend, Wash.	214
San Francisco	555
Seattle, Wash.	252
Tacoma, Wash.	279
Tatoosh, Wash.	126
Willapa Bar	38

INLAND WATERS
ASTORIA

DISTANCES FROM ASTORIA, ORE., TO COLUMBIA RIVER AND WILLAMETTE RIVER LOADING POINTS

The distances are from Astoria at a point known as the Mack Dock, where all bearings are taken. The Portland distance terminates at the Steel Bridge.

	Statute Miles
Knappton, Wash.	12
Wauna, Ore.	28
Westport, Ore.	30
Oak Point, Wash.	40
Stella, Wash.	42½
Rainier, Ore.	54½
Prescott, Ore.	57
Goble, Ore.	60
Kalama, Wash.	60
Saint Helens, Ore.	73
Linnton, Ore.	92½
Vancouver, Wash.	94
Saint Johns, Ore.	95
Portland, Ore.	100

To facilitate the loading and unloading of vessels the Port of Astoria has a 50-ton movable crane and bunkers that hold 20,000 tons of coal.

BORDEAUX

Bordeaux, France, to—	Route—	Nautical Miles
Acapulco, Mexico	Via Panama Canal	6,067
Do	Via Magellan Strait	11,651
Aden, Arabia	Via Suez Canal	4,351
Callao, Peru	Via Panama Canal	5,987
Do	Via Magellan Strait	9,740
Colon, C. Z.	Via Mona Passage	4,598
Coronel, Chile	Via Panama Canal	7,463
Do	Via Magellan Strait	8,262
Guayaquil (Puna), Ecuador	Via Panama Canal	5,434
Do	Via Magellan Strait	10,342
Habana, Cuba	Via NE. Providence Channel	4,188
Honolulu, Hawaii	Via Panama Canal	9,326
Do	Via Magellan Strait	13,439
Iquique, Chile	Via Panama Canal	6,628
Do	Via Magellan Strait	9,270
Panama, C. Z.	Via Mona Passage	4,641
Pernambuco, Brazil		3,823
Portland, Oreg., U. S. A.	Via Panama Canal and San Francisco	8,536
Do	Via Magellan Strait and San Francisco	13,912
Port Townsend, Wash., U. S. A.	Via Panama Canal and San Francisco	8,656
Do	Via Magellan Strait and San Francisco	14,032
Punta Arenas, Chile	East of South America	7.074
Do	Via Panama Canal	8,584
San Diego, Cal., U. S. A.	do	7,484
Do	Via Magellan Strait	12,870
San Francisco, Cal., U. S. A.	Via Panama Canal	7,886
Do	Via Magellan Strait	13,262
San Jose, Guatemala	Via Panama Canal	5,527
Do	Via Magellan Strait	11,365
Sitka, Alaska	Via Panama Canal and San Francisco	9,188
Do	Via Magellan Strait and San Francisco	14,564
Valparaiso, Chile	Via Panama Canal	7,257
Do	Via Magellan Strait	8,507
Vancouver, B. C.	Via Panama Canal	8,673
Do	Via Magellan Strait	14,047

BREST

Brest, France, to—	Route—	Nautical Miles
Colon, C. Z.	Via Mona Passage	4,420
Gravesend, England		392
Guantanamo Bay (Caimanera), Cuba		3,791
New York (The Battery), N. Y., U. S. A.	Winter; westbound	2,994
Do	Summer; westbound	3,072
Rio de Janeiro, Brazil		4,841
San Francisco, Cal., U. S. A.	Via Rio de Janeiro and Magellan Strait	13,271
Do	Via Mona Passage and Panama	7.708

BUENOS AIRES

Buenos Aires, Argentina, to—	Route—	Nautical Miles
Asuncion, Paraguay		827
Colon, C. Z.	North of South America	5,450
Los Angeles Hbr. (San Pedro), Cal., U. S. A.	Via Panama Canal	8,406
Punta Arenas, Chile		1,383
Rosario, Argentina		210
Southampton, England		5,762

CALLAO

Callao, Peru, to—	Route—	Nautical Miles
Antofagasta, Chile		813
Arica, Chile		593
Caldera, Chile		980
Chimbote, Peru		206
Coquimbo, Chile		1,136
Houolulu, Hawaii		5,161
Iquique, Chile		659
Los Angeler Harbor (San Pedro), Cal. U. S. A.		3,655
Lota, Chile		1,530
Magdalena Bay, Mexico		3,008
Mollendo, Peru		468
Panama, C. Z.		1,346
Pisco, Peru		128
Punta Arenas, Chile		2,671
Talcahuano, Chile		1,508
Valdivia (P. Corral), Chile		1,691
Valparaiso, Chile		1,306

COLON

Colon, Canal Zone, to—	Route—	Nautical Miles
Apalachicola, Fla., U. S. A.		1,287
Balboa, C. Z.		38
Baltimore, Mr., U. S. A.	Via Windward and Crooked I. Passages	1,901
Barbados (Bridgetown), W. I.		1,237
Bishops Rock, England	Via Anegada Passage	4,395
Bishops Rock, England	Via Mona Passage	4,356
Bluefields, Nicaragua		276
Bocas del Toro, Panama		144
Bordeaux, France	Via Mona Passage	4,598
Boston, Mass., U. S. A.	Via Windward and Crooked I. Passages; outside Nantucket Lightvessel.	2,157
Brunswick, Ga., U. S. A.	Via Windward and Crooked I. Passages	1,550
Buenos Aires, Argentina	North of South America	5,450
Campeche, Mexico		1,167
Cape Haitien, Haiti		817
Carmen, Mexico		1,246
Cartagena, Colombia		281
Ceiba, Honduras		666
Charleston, S. C., U. S. A.	Via Windward and Crooked I. Passages	1,564
Charleston, S. C., U. S. A.	Via Yucatan Channel; northbound	1,636
Culebra I. (The Sound), W. I.	Outside Crab I. and via Sauth Channel	1,918
Curacao (Santa Ana Harbor), W. I.		699
Fort de France, Martinique, W. I.		1,159
Galveston, Tex., U. S. A.		1,493
Gigraltar	Via St. Thomas	4,343
Do	Via Anegeda Passage	4,332
Gibraltar, Strait of (lat. 35° 57′ N., long. 5° 45′ W.).	do	4,308
Glasgow, Scotland	Via Mona Passage	4,523
Gracias a Dios, Nicaragua		399
Grijalva (Tabasco) River, Mexico		1,280
Guantanamo Bay (Caimanera), Cuba.		696
Gulfport, Miss., U. S. A.	Northbound	1,388
Habana, Cuba	Via Yucatan Channel	1,003
Halifax, Nova Scotia	Via Windward and Crooked I. Passages	2,317
Hamburg, Germany	Via Mona Passage	5,070
Hampton Roads, Va., U. S. A.	Via Windward and Crooked I. Passages	1,768
Havre ,France	Via Mona Passage	4,614
Horn I. Arch., Gulf of Mexico	Northbound	1,373
Hull, England	Via Mona Passage	4,884
Iriona, Honduras		566
Jacksonville, Fla., U. S. A.	Via Yucatan Channel; northbound	1,535
Key West, Fla., U. S. A.		1,065
Kingston, Jamaica, W. I.		551
La Guaira, Venezuela		841
Liverpool, England	Via Mona Passage	4,548

COLON—Continued

Colon, C. Z., to—	Route—	Nautical Miles
Livingston, Guatemala		772
Los Angeles, Hbr. (San Pedro), Cal., U. S. A.		2,956
Margarita I. (La Mar Bay), Venezuela.		1,012
Matagorda Bay (Entr.), Tex., U. S. A.		1,515
Mississippi River (South Pass; (lat. 28° 59′ N., long. 89° 07′ W.).	Northbound	1,308
Mississippi River (S. W. Pass; (lat. 28° 53′ N., long. 89° 27′ W.).	do	1,309
Mobile, Ala., U. S. A.	do	1,393
Mona Passage (lat. 18° 03′ N., long. 67° 47′ W.), W. I.		880
Monkey Pt. Hbr., Nicaragua		259
New Orleans, La., U. S. A.	Northbound; via South Pass	1,403
Do	Northbound; via S. W. Pass	1,419
New York (The Battery), N. Y., U. S. A.	Via Windward and Crooked I. Passages	1,974
Newport, R. I., U. S. A.	do	2,028
Newport News, Va., U. S. A.	do	1,776
Norfolk, Va., U. S. A.	do	1,779
Do	Via Yucatan Channel; northbound	2,006
Panama Roads, C. Z.	Via Panama Canal	43
Pensacola, Fla., U. S. A.	Northbound	1,369
Philadelphia, Pa., U. S. A.	Via Windward and Crooked I. Passages	1,946
Plymouth, England	Via St. Thomas	4,500
Do	Via Mona Passage	4,455
Do	Via Anegada Passage	4,494
Port Arthur, Tex.		1,485
Port Castries, St Lucia, W. I.		1,160
Port Limon, Costa Rica		192
Port Morelos, Yucatan		828
Port of Spain, Trinidad, W. I.		1,159
Port Royal, Jamaica, W. I.		546
Port Tampa, Fla., U. S. A.		1,212
Portsmouth, N. H., U. S. A.	Via Windward and Crooked I. Passages outside Nantucket Lightvessel.	2,174
Provincetown, Mass., U. S. A.	Via Windward and Crooked I. Passages	2,126
Puerto Barrios, Guatemala		780
Puerto Cabello, Venezuela		802
Puerto Cortes, Honduras		733
Puerto Mexico, Mexico		1,377
Rio de Janeiro, Brazil		4,348
Rio Grande (Entr.)		1,484
Roatan Island (Coxen Hole		641
Sabine, Tex., U. S. A.		1,476
St. Thomas, W. I.		1,029
San Juan, P. R.		993
Sandy Hook, N. J., U. S. A.	Via Windward and Crooked I. Passages	1,964
Savannah, Ga., U. S. A.	Via Yucatan Channel! northbound	1,607
Southport, N. C., U. S. A.	Via Windward and Crooked I. Passages	1,592
Tampico, Mexico		1,485
Tela, Honduras		706
Trinidad (Dragons Mouths; lat 10° 43′ N., long. 61° 45′ W.), W. I.		1,142
Trujillo, Honduras		622
Tuxpam, Mexico		1,455
Vera Cruz, Mexico		1,420
Virgin Passage (lat. 18° 20′ N., long. 65° 07′ W.), W. I.		1,021
Wilmington, N. C., U. S. A.	Via Yucatan Channel; northbound	1,730
Windward Passage (lat. 20° 10′ N., long. 74° 00′ W.), W. I.		734
Yucatan Channel (lat. 21° 50′ N., long. 85° 03′ W.).		812

EUREKA

Eureka, Humboldt Bay, California, U. S. A. to—	Route—	Nautical Miles
Astoria, Oregon		343
Bellingham, Wash.		594
Cape Flattery, Wash.		464
Coos Bay, Oregon		159
Grays Harbor, Wash., "Whistle Buoy."		371
Honolulu, Hawaii		2,139
Los Angeles Harbor (San Pedro), Cal.		584
Manilla, P. I.	Via Honolulu	6,906
Panama Roads, Canal Zone		3,461
Port Townsend, Wash.		548
San Francisco, Cal.		216
San Diego, Cal.		668
Seattle, Wash.		588
Tacoma, Wash.		610
Union Bay, B. C.		659
Vancouver, B. C.		617
Victoria, B. C.		534
Willapa Harbor, Wash., "Whistle Buoy."		355

GIBRALTAR

Gibraltar to—	Route—	Nautical Miles
Acapulco, Mexico	Via Anegada Passage and Panama Canal	5,801
Do	Via Magellan Strait	10,960
Aden, Arabia		3,321
Alexandria, Egypt		1,810
Algiers, Algeria		425
Barcelona, Spain		516
Calloa, Peru	Via Anegada Passage and Panama Canal	5,721
Do	Via Magellan Strait	9,049
Colon, C. Z.	Via Anegada Passage	4,332
Do	Via St. Thomas, W. I.	4,343
Constantinople, Turkey	Via Messina Strait and Corinth Canal	1,823
Do	Via South of Sicily and Cervi and Duro Channels.	1,824
Coronel, Chile	Via Anegada Passage and Panama Canal	7,197
Do	Via Magellan Strait	7,571
Fayal (Horta), Azores		1,133
Genoa, Italy		860
Guayaquil (Puna), Ecuador	Via Anegada Passage and Panama Canal	5,168
Do	Via Magellan Strait	9,651
Hongkong	Via Anegada Passage and Panama Canal	13,570
Do	Via Suez Canal	8,409
Honolulu, Hawaii	Via Anegada Passage and Panama Canal	9,060
Do	Via Magellan Strait	12,748
Iquique, Chile	Via Anegada Passage and Panama Canal	6,362
Do	Via Magellan Strait	8,579
Lisbon, Portugal		304
Liverpool, England		1,294
Livorno, (Leghorn), Italy		875
London, England		1,351
Malta (Valetta Hbr.)		990
Manila, P. I.	Via Anegada Passage, Panama Canal, and San Bernardino Strait.	13,745
Do	Via Anegada Passage, Panama Canal and Balintang Channel.	13,722
Do	Via Suez, Aden, Colombo, Singapore... S. of Sokotra I.	8,372
Marseille, France		693
Naples, Italy		982
New York (The Battery), N. Y., U. S. A.	Winter; westbound	3,201
Do	Summer; westbound	3,207
Odessa, Russia	Via Messina Strait and Corinth Canal	2,170
Do	Via South of Sicily and Cervi and Duro Channels.	2,171

GIBRALTAR—Continued

Gibraltar to—	Route—	Nautical Miles
Panama, C. Z.	Via Anegeda Passage	4,375
Plymouth, England		1,060
Port Said, Egypt		1,925
Port Townsend, Wash., U. S. A.	Via Anegada Passage, Panama Canal, and San Francisco.	8,390
Do	Via Magellan Strait and San Francisco	13,341
Portland, Ore, U. S. A.	Via Anegada Passage, Panama Canal and San Francisco.	8,270
Do	Via Magellan Strait and San Francisco	13,221
Punta Arenas, Chile		6,383
San Diego, Cal.	Via Anegada Passage and Panama Canal	7,218
Do	Via Magellan Strait	12,179
San Francisco, Cal.	Via Anegada Passage and Panama Canal	7,620
Do	Via Magellan Strait	12,571
San Jose, Guatemala	Via Anegada Passage and Panama Canal	5,261
Do	Via Magellan Strait	10,674
Sfax, Tunis		1,060
Sitka, Alaska	Via Anegada Passage, Panama Canal, and San Francisco.	8,922
Do	Via Magellan Strait and San Francisco	13,873
Smyrna, Turkey	Via Messina Strait and Corinth Canal	1,672
Do	Via South of Sicily and Cervi and Duro Channels.	1,676
Sydney, Australia	Via Panama and Tahiti	12,169
Do	Via Suez Canal	10,237
Toulon, France		705
Trieste, Austria-Hungray		1,693
Tripoli, Tripoli		1,118
Valparaiso, Chile	Via Anageda Passage and Panama Canal	6,991
Do	Via Magellan Strait	7,816
Vancouver, B. C.	Via Anegada Passage and Panama Canal	8,407
Do	Via Magellan Strait	13,356
Wellington, New Zealand	Via Anegada Passage, Panama Canal, and Tahiti.	11,209
Do	Via Suez Canal	11,156
Yokohama, Japan	Via Anegada Passage and Panama Canal	12,057
Do	Via Anegada Passage, Panama Canal, and San Francisco.	12,156
Do	Via Suez, Hongkong, Shanghai, and Van Diemen Strait.	10,302
Do	Via Suez, Aden, Colombo, and Singapore	9,907
Do	Via Suez Canal	9,859

GRAYS HARBOR

Grays Harbor, Wash., "Whistle Buoy," to—	Route—	Nautical Miles
Astoria, Oregon		53
Eureka, Humboldt Bay		371
Honolulu, Hawaii		2,281
Los Angeles Harbor, (San Pedro), Cal.		972
Manila	Via Honolulu	7.084
Port Townsend, Wash.		179
San Francisco, Cal.		604
Seattle, Wash.		218
Tacoma, Wash.		243
Vancouver, B. C.		232
Victoria, B. C.		155
Willapa Harbor, Wash., "Whistle Buoy"		15½

HONOLULU

Honolulu, Hawaii, to—	Route—	Nautical Miles
Astoria, Ore., U. S. A.		2,246
Auckland, New Zealand		3,820
Brisbane Roads, Australia		4,169
Callao, Peru		5,161
Cape Horn, South America		6,472
Chimbote, Peru		5,015
Christmas I., N. Pacific Ocean		1,161
Dutch Harbor, Unalaska I., Alaska		2,046
Fanning Island		1,056
Gaum (Port Apra), Marianas		3,337
Do	Via Tarawa I., Gilbert Is.	3,944
Gulf of Fonseca (Monypenny Pt.) Nicaragua.		4,038
Hobart, Tasmania		4,930
Hongkong	Rhumb	4,939
Jaluit, Marshal I.		2,096
Johnston I., Hawaii		717
Juan Fernandez I. (San Juan Bautista Bay).		5,595
Kusaie I., Caroline I.		2,467
Laysan Island, H. I.		820
Levuka, Fiji I.		2,730
Los Angeles Harbor (San Pedro), Cal., U. S. A.		2,228
Magdalena Bay, Mexico		2,543
Manila, P. I.	Via north end of Luzon, P. I.	4,869
Do	Via Guam and north end of Luzon, P. I.	5,079
Do	Via Guam and San Bernardino Strait	4,838
Do	Via San Bernardino Strait	4,767
Marquesas Is., Nukuhiva (Taiohae)		2,102
Marshal Is. (Eniwetok Atoll		2,375
Melbourne, Australia	Via South Channel	4,942
Midway Is. (Welles Hbr.)		1,149
New Hebrides (St. Philip and St. James Bay).		3,014
New York (The Battery). N. Y., U. S. A.	Via Magellan Strait	13,312
Do.	Via Panama Canal, and Windward and Crooked I. Passages.	6,702
Nonuti, Gilbert Is.		2,100
Noumea, New Caledonia		3,373
Nukunono, Union Is.		2,309
Pago Pago, Samoa Is.		2,276
Panama, C. Z.		4,685
Pelew Is. (Korror Hbr.)		3,997
Petropavlovsk, Kamchatka		2,762
Point Conception, Cal., U. S. A.		2,126
Ponape, Caroline Is.		2,685
Port Lloyd, Ogasawara Is.		3,283
Port Townsend, Wash., U. S. A.		2,366
Portland, Ore., U. S. A.		2,332
Punta Arenas, Chile		6,370
Raoul Is., Kermadec Is.		3,246
Rarotonga, Cook Is.		2,553
Salina Cruz, Mexico		3,580
San Bernardino Strait (Entr.), P. I.		4,457
San Diego, Cal., U. S. A.		2,278
San Francisco, Cal., U. S. A.		2,091
Sandakan, Borneo		5,044
Seattle, Wash., U. S. A.		2,409
Sitka, Alaska		2,386
Sydney, Australia		4,420
Tahiti (Papeete), Society Is.		2,381
Tarawa Island, Gilbert Is.		2,100
Tongatabu (Nukualofa), Tonga Is.		2,749
Ugi Is. (Selwyn Bay), Solomon Is.		3,047
Valparaiso, Chile		5,919
Vancouver, B. C.		2,423
Victoria, British Columbia		2,349
Vladivostok, Siberia		3,725
Wake Island		2,004
Wellington, New Zealand		4,113
Yap (Tomill Hbr.), Caroline Is.		3,757
Yokohama, Japan	Rhumb	3,445
Do	Great Circle	3,394

IQUIQUE

Iquique, Chile, to—	Route—	Nautical Miles
Antofagasta, Chile		224
Caldera, Chile		420
Coquimbo, Chile		602
Lota, Chile		1,033
Punta Arenas, Chile		2,201
Talcahuano, Chile		1,008
Valdivia (P. Corral), Chile		1,205
Valparaiso, Chile		782
Yokohama, Japan		9,026

LIVERPOOL

Liverpool, England, to—	Route—	Nautical Miles
Acapulco, Mex	Via Panama Canal	6,017
Do	Via Magellan Strait	11,891
Adelaide, Australia	Via Panama, Tahiti, Sydney, and Melbourne.	13,478
Do	Via Suez Canal, Aden, Colombo, and King George Sound.	11,108
Baltimore, Md., U. S. A.	Winter; westbound	3,373
Do	Summer; westbound	3,454
Boston, Mass., U. S. A.	Winter; westbound	2,895
Do	Summer; westbound	3,010
Callao, Peru	Via Panama Canal	5,937
Do	Via Magellan Strait	9,980
Colon, C. Z.	Via Mona Passage	4,548
Coronel, Chile	Via Panama Canal	7,413
Do	Via Magellan Strait	8,502
Galveston, Tex., U. S. A.	Winter; westbound; via NE. Providence Channel and south of Dry Tortugas.	4,749
Do	Summer; westbound; via NE. Providence Channel and south of Dry Tortugas.	4,766
Gibraltar		1,294
Guayaquil (Puna), Ecuador	Via Panama Canal	5,384
Do	Via Magellan Strait	10,582
Hongkong	Via Panama and direct	13,764
Do	Via Panama, San Francisco, and Yokohama.	13,957
Do	Via Suez Canal, Aden, Colombo, and Singapore.	9,743
Do	Via Magellan Strait, Pago Pago, and Guam.	17,432
Honolulu, Hawaii	Via Panama Canal	9,276
Do	Via Magellan Strait	13,679
Iquique, Chile	Via Panama Canal	6,578
Do	Via Magellan Strait	9,510
Las Palmas, Canary Is.		1,661
Manila, P. I.	Via Magellan Strait, Pago Pago, and Guam.	17,111
Do	Via Panama Canal and San Bernardino Strait.	13,961
Do	Via Panama, San Francisco, and Yokohama.	14,129
Do	Via Suez Canal, Aden, Colombo, and Singapore.	9,659
Do	Via Suez Canal, Colombo, and Singapore.	9,649

LIVERPOOL—Continued

Liverpool, England, to—	Route—	Nautical Miles
Melbourne, Australia	Via Cape of Good Hope	12,137
Do	Via Cape Town	12,157
Do	Via Panama Canal	12,519
Do	Via Suez Canal	11,084
Do	Via Panama, Tahiti, and Sydney	12,966
Do	Via Suez Canal, Aden, Colombo, King George Sound, and Adelaide.	11,620
Mobile, Ala., U. S. A.	Winter; westbound; via NE. Providence Channel and south of Dry Tortugas.	4,520
Do	Summer; westbound; via NE. Providence Channel and south of Dry Tortugas.	4,537
New Orleans, La., U. S. A.	Winter westbound; via NE. Providence Channel, south of Dry Tortugas, and SW. Pass.	4,589
Do	Summer; westbound; via NE. Providence Channel, south of Dry Tortugas, and S.W. Pass.	4,606
New York (The Battery), N. Y., U. S. A.	Winter; westbound	3,073
Do	Summer; westbound	3,171
Newport News, Va., U. S. A.	Winter; westbound	3,249
Do	Summer; westbound	3,330
Panama, C. Z.	Via Mona Passage	4,591
Pensacola, Fla., U. S. A.	Winter; westbound; via NE. Providence Channel and south of Dry Tortugas-	4,480
Do	Summer; westbound; via NE. Providence Channel and south of Dry Tortugas.	4,497
Pernambuco, Brazil	Direct	4,062
Do	Via Scilly Is. (St. Mary's Anch.)	4,078
Philadelphia, Pa., U. S. A.	Winter; westbound	3,226
Do	Summer; westbound	3,324
Port Nelson, Saskatchewan, Canada		3,009
Port Townsend, Wash., U. S. A.	Via Panama and San Francisco	8,606
Do	Via Magellan Strait and San Francisco	14,272
Portland, Ore., U. S. A.	Via Panama and San Francisco	8,486
Do	Via Magellan Strait and San Francisco	14,152
Punta Arenas, Chile	Direct	7,314
Do	Via Scilly Is. (St. Marys Anch.)	7,329
St. Thomas, W. I.		3,574
San Diego, Cal., U. S. A.	Via Panama Canal	7,434
Do	Via Magellan Strait	13,110
San Francisco, Cal., U. S. A.	Via Panama Canal	7,836
Do	Via Magellan Strait	13,502
San Jose, Guatemala	Via Panama Canal	5,477
Do	Via Magellan Strait	11,605
Sitka, Alaska	Via Panama and San Francisco	9,138
Do	Via Magellan Strait and San Francisco	14,804
Sydney, Australia	Via Panama and Tahiti	12,385
Do	Via Suez Canal, Aden, Colombo, King George Sound, Adelaide, and Melbourne.	12,201
Valparaiso, Chile	Via Panama Canal	7,207
Do	Via Magellan Strait	8,747
Vancouver, British Columbia	Via Panama Canal	8,623
Do	Via Magellan Strait	14,287
Vladivostok, Siberia	Via Suez Canal, Colombo, and Singapore.	11,282
Wellington, New Zealand	Via Cape Town	13,353
Do	Via Panama Canal and direct	11,096
Do	Via Panama and Tahiti	11,425
Do	Via Suez Canal, Aden, Colombo, King George Sound, and Melbourne.	12,955
Do	Via Suez Canal and direct	12,462
Yokahama, Japan	Via Magellan Strait and Pago Pago	16,584
Do	Via Panama Canal and direct	12,273
Do	Via Panama and San Francisco	12,372
Do	Via Suez Canal, Aden, Colombo, Singapore, Hongkong, and Shanghai.	11,636

LONDON

London, England, to—	Route—	Nautical Miles
Baltimore, Md., U. S. A.	Winter; westbound	3,610
Do	Summer; westbound	3,681
Bishops Rock (lat. 49° 50′ N., long. 6° 27′ W.).		407
Boston, Mass., U. S. A.	Winter; westbound	3,132
Do	Summer; westbound	3,237
Cape Town, Africa		6,139
Christiania, Norway		658
Copenhagen, Denmark		704
Gibraltar		1,351
Havre, France		203
Hongkong	Via Suez Canal	9,749
Lisbon, Portugal		1,062
Melbourne, Australia	Via Panama	12,734
New York (The Battery), N. Y., U. S. A.	Winter; westbound	3,310
Do	Summer; westbound	3,398
Newport News, Va., U. S. A.	Winter; westbound	3,486
Do	Summer; westbound	3,557
Pernambuco, Brazil		4,136
Petrograd, Russia		1,519
Philadelphia, Pa., U. S. A.	Winter; westbound	3,463
Do	Summer; westbound	3,551
Plymouth, England		321
Port Arthur, Tex., U. S. A.	Winter; westbound; via N. E. Providence Channel and South of Dry Tortugas.	4,963
Do	Summer; westbound; via N. E. Providence Channel and South of Dry Tortugas.	4,970
Southampton, England		215
Stockholm, Sweden		1,251
Sydney, Australia	Via Cape of Good Hope	12,663
Do	Via Suez Canal	11,603
Tornea, Russia		1,659

LOS ANGELES HARBOR (San Pedro)

Los Angeles Hbr. (San Pedro), Cal., U. S. A., to—	Route—	Miles Nautical
Buenos Aires, Argentina	Via Panama Canal	8,436
Callao, Peru		3,655
Colon, C. Z.	Via Panama Canal	2,956
Honolulu, Hawaii		2,228
Manila, P. I.	Via Honolulu and San Bernardino Strait.	6,995
Do	Via San Bernardino Strait	6,588
Panama, C. Z.		2,913
Portland, Ore., U. S. A.		989
Rio de Janeiro, Brazil	Via Panama Canal	7,305
Salina Cruz, Mexico		1,803
San Diego, U. S. A.		97
San Francisco, Cal., U. S. A.		368
Santa Cruz, Cal., U. S. A.		295
Valparaiso, Chile		4,808
Victoria, B. C.		1,091
Yokohama, Japan		4,839

MANILA

Manila, P. I., to—	Route—	Nautical Miles
Batavia, Java	Via Palawan Passage	1,559
Borongan, Samar, P. I.		435
Bremen, Germany	Via Suez Canal and Singapore	9,955
Brisbane Roads, Australia	Via Mindoro and Torres Straits and inside route.	3,552
Cairns, Australia	do.	2,723
Cebu, P. I.	Via Verde I. and Jintotolo Passages	391
Colombo, Ceylon		2,952
Friederich Wilhelmshafen, Papua	Via San Bernardino Strait	2,011
Guam (Port Apa), Marianas	Via north end of Luzon, P. I.	1,742
Do	Via San Bernardino Strait	1,501
Honolulu, Hawaii	Via north end of Luzon, P. I.	4,869
Do	Via San Bernardino Strait	4,767
Do	Via north end of Luzon, P. I. and Guam	5,079
Iloilo, P. I.	Via Verde I. and Jintotolo Passages	361
Jolo, Jolo I., P. I.	Via West Apo Channel	550
Limay, Luzon, P. I.		22
Liverpool, England	Via Singapore, Colombo, and Suez Canal	9,649
Do	Via Guam, Pago Pago, and Magellan Strait.	17,111
London, England	Via Suez Canal	9,656
Mangarin, Mindoro, P. I.		170
Melbourne, Australia	Via Mindoro and Torres Straits and inside route.	4,528
Moji, Japan		1,436
Newcastle, Australia	Via Mondoro and Torres Straits and inside route.	3,917
Olongapa, Luzon, P. I.		64
Pago Pago, Samoa Is.	Via San Bernardino Strait	4,505
Panama, C. Z.	Via Balintang Channel and Cape San Lucas.	9,347
Do	Via San Bernardino Strait	9,370
Pelew Is. (Korror Hbr.)	Via Verde I. Passage and between Maranjos Gr. and Copul I.	1,044
Port Darwin, Australia	Via Mindoro, Basilan, Banka, and Manipa Straits.	1,834
Port Townsend, Wash., U. S. A.	Composite Great Circle	5,931
Rabaul, Neu Pommern	Via San Bernardino Strait	2,281
Saigon, Cochin-China		907
San Francisco, Cal., U. S. A.	Via Balintang Channel	6,221
Do	Via San Bernardino Strait	6,301
Seattle, Wash., U. S. A.	Via Yokohama	6,012
Do	Via San Bernardino Strait, Guam, and Honolulu.	7,247
Singapore, Straits Settlements		1,370
Southampton, England	Via Singapore and Suez Canal	9,488
Sydney, Australia	Via Mindoro and Torres Straits and inside route.	3,967
Torres Strait (Thursday Island)	Via Mindoro Strait	2,227
Townsville, Australia	Via Mindoro and Torres Straits and inside route.	2,881
Wake Island	Via San Bernardino Strait	2,772
Wyndham, Australia	Via Mindoro, Basilan, Banka, and Manipa Straits.	1,982
Yap I. (Tomill Hbr.), Caroline Is.	Via San Bernardino Strait	1,154
Yokohama, Japan	Via Balintang Channel	1,757
Do	Via Hongkong, Shanghai, Nagasaki, Inland Sea, and Kobe.	2,683
Zamboanga, Mindanao, P. I.	Via East Apo Channel	532

NEWPORT NEWS, VA., U. S. A.

As the distance between Newport News, Va., and Norfolk, Va., is only three miles, use the Norfolk table as it is close enough for all practical purposes.

NORFOLK

Norfolk, Va., U. S. A., to—	Route—	Nautical Miles
Acapulco, Mexico	Via Panama Canal	3,248
Do	Via Magellan Strait	11,476
Adelaide, Australia	Via Panama, Tahiti, Sydney, and Melbourne.	10,709
Do	Via St. Vincent and Cape Town	12,709
Baltimore, Md., U. S. A.		172
Barcelona, Spain	Great Circle C. Charles Light-vessel to C. St. Vincent.	3,881
Belize, British Honduras	Via Straits of Florida; south-bound; outside.	1,503
Bocas, del Toro, Panama	Via Crooked I. and Windward Passages	1,853
Boston, Mass., U. S. A.	Via Vineyard Sound and Pollock Rip Slue.	518
Bremen, Germany	Winter, eastbound	3,793
Do	Summer, eastbound	3,877
Buenos Aires, Argentina		5,824
Callao, Peru	Via Panama Canal	3,168
Do	Via Magellan Strait	9,565
Cartagena, Colombia	Via Crooked I. and Windward Passages	1,658
Colombo, Ceylon	Great Circle C. Charles Light-vessel to C. St. Vincent.	8,769
Colon, C. Z.	Via Crooked I. and Windward Passages	1,779
Coronel, Chile	Via Magellan Strait	8,087
Do	Via Panama Canal	4,644
Genoa, Italy	Great Circle, C. Charles Light-vessel to C. St. Vincent.	4,222
Georgetown, British Guiana		2,090
Georgetown, S. C., U. S. A.		388
Gibraltar	Great Circle, C. Charles Light-vessel to C. St. Vincent.	3,369
Guam (Port Apra), Marianas	Via Magellan Strait	14,921
Do	Via Panama Canal	9,810
Do	Via Suez Canal and Sunda Strait	13,234
Guayaquil (Puna), Ecuador	Via Panama Canal	2,615
Do	Via Magellan Strait	10,167
Habana, Cuba	Southbound; outside	985
Hampton Roads (off light), Va. U. S. A.		11
Hongkong	Via Panama, San Francisco, Yokohama, and Shanghai.	11.496
Do	Via Panama, Honolulu, Yokohama, and Shanghai.	11,794
Do	Via Panama, Honolulu, Guam, and Manila.	11,976
Do	Via Suez Canal, Colombo, and Singapore	11,808
Honolulu, Hawaii	Via Panama Canal	6,507
Do	Via Magellan Strait	13,264
Iquique, Chile	Via Panama Canal	3,809
Do	Via Magellan Strait	9,095
Key West, Fla., U. S. A.	Outside; southbound	927
Kingston, Jamaica	Via Crooked I. and Windward Passages	1,279
Liverpool, England	Winter, eastbound	3,272
Do	Summer, eastbound	3,367
Livingston, Guatemala	Via Straits of Florida; southbound; outside.	1,595
London, England	Winter, eastbound	3,506
Do	Summer, eastbound	3,590
Manila, P. I.	Via Panama, San Francisco, and Yokohama.	11,360
Do	Via Panama, Honolulu, Yokohama, Shanghai, and Hongkong.	12,425
Do	Via Panama, Honolulu, and Yokohama.	11,658
Do	Via Panama, Honolulu, and Guam.	11,345
Do	Via Suez Canal, Colombo, and Singapore	11,724
Melbourne, Australia	Via Panama, Tahiti, and Sydney	10,197
Do	Via St. Vincent, Cape Town, and Adelaide.	13,221
New York (The Battery), N. Y., U. S. A		292
Panama, C. Z.	Via Crooked I. and Windward Passages	1,822
Philadelphia, Pa., U. S. A.		260
Port Antonio, Jamaica	Via Crooked I. and Windward Passages	1,228
Port Banes, Cuba	Via Crooked I. Passage	1,018
Port Limon, Costa Rica	Via Crooked I. and Windward Passages	1,852
Port Said, Egypt		5,287

NORFOLK—Continued

Norfolk, Va., U. S. A., to—	Route—	Nautical Miles
Port Townsend, Wash., U. S. A.	Via Panama and San Francisco	5,837
Do	Via Magellan Strait and San Francisco	13,857
Portland, Ore., U. S. A.	Via Panama and San Francisco	5,717
Do	Via Magellan Strait and San Francisco	13,737
Preston, Cuba	Via Crooked I. Passage	1,021
Providence, R. I., U. S. A.		398
Puerto Barrios, Guatemala	Via Straits of Florida; southbound; outside.	1,603
Puerto Cortes, Honduras	do	1,568
Punta Arenas, Chile	East of South America	6,900
Do	Via Panama Canal	5,765
Rio de Janeiro, Brazil		4,723
Rotterdam, Netherlands	Winter, eastbound	3,552
Do	Summer, eastbound	3,636
St. Vincent (Porto Grande), C. Verde Islands.		2,973
San Diego, Cal., U. S. A.	Via Panama Canal	4,665
Do	Via Magellan Strait	12,695
San Francisco, Cal., U. S. A.	Via Panama Canal	5,067
Do	Via Magellan Strait	13,087
San Jose, Guatemala	Via Panama Canal	2,708
Do	Via Magellan Strait	11,190
San Juan del Norte (Greytown), Nicaragua.	Via Crooked I. and Windward Passages	1,837
Do	Via Straits of Florida, southboun; outside.	1,846
Santa Marta, Colombia	Via Crooked I. and Windward Passages	1,588
Savannah, Ga., U. S. A.		499
Shanghai, China	Via Panama, San Francisco, and Tsugaru Strait.	10,454
Do	Via Panama, Honolulu, and Yokohama	10,942
Do	Via Suez, Colombo, Singapore, and Hongkong.	12,660
Sitka, Alaska	Via Panama and San Francisco	6,369
Do	Via Magellan Strait and San Francisco	14,389
Sydney, Australia	Via Panama and Tahiti	9,616
Do	Via St. Vincent, Cape Town, Adelaide, and Melbourne.	13,802
Valparaiso, Chile	Via Panama Canal	4,438
Do	Via Magellan Strait	8,332
Washington, D. C., U. S. A.	Inside Tail of Horseshoe Light-vessel	173
Do	Outside Tail of Horseshoe Light-vessel	187
Wellington, New Zealand	Via Panama and Tahiti	8,656
Do	Via Magellan Strait	11,296
Do	Via St. Vincent, Cape Town, and Melbourne.	14 500
Wilmington, N. C., U. S. A.		358
Yokohama, Japan	Via Panama and San Francisco	9,603
Do	Via Panama and Honolulu	9,901
Do	Via Suez, Colombo, Singapore, Hongkong, and Shanghai.	13,701

PAITA

Paita, Peru, to—	Route—	Nautical Miles
Antofagasta, Chile		1,299
Apia, Samoa Is.		5,365
Arica, Chile		1,080
Caldera, Chile		1,461
Callao, Peru		595
Coquimbo, Chile		1,609
Honolulu, Hawaii		4,725
Iquique, Chile		1,146
Lota, Chile		1,983
Mollendo, Peru		955
Pascasmayo, Peru		201
Pisco, Peru		617
Punta Arenas, Chile		3,101
Tahiti (Papeete), Society Is.		4.082
Talcahuano, Chile		1,963
Valdivia (Port Corral), Chile		2,141
Valparaiso, Chile		1,774

PANAMA ROADS

Panama Roads, Canal Zone, to—	Route—	Nautical Miles
Acapulco, Mexico		1,426
Amapala, Honduras		745
Antofagasta, Chile		2,149
Antwerp, Belgium	Via Mona Passage	4,851
Apalachicola, Fla., U. S. A.		1,330
Apia, Samoa Is.		5,710
Arica, Chile		1,921
Auckland, New Zealand		6,512
Baltimore, Md., U. S. A.	Via Windward and Crooked I. Passages	1,944
Barbados (Bridgetown), W. I.		1,280
Belize, Brit. Honduras		859
Bishops Rock (lat. 49° 50′ N., long. 6° 27′ W.)	Via Anegada Passage	4,438
Do	Via Mona Passage	4,399
Blanche Bay, Neu Pommern		7,807
Bluefields, Nicaragua		319
Bocas del Toro, Panama		187
Bombay, India	Via San Bernardino Strait	12,957
Bordeaux, France	Via Mona Passage	4,641
Boston, Mass., U. S. A.	Via Windward and Crooked I. Passages and outside Nantucket Lightvessel.	2,200
Brunswick, Ga., U. S. A.	Via Windward and Crooked I. Passages	1,593
Calcutta, India	Via San Bernardino Strait	12,148
Caldera, Chile		2,302
Caleta Buena (Buena Cove), Chile		1,977
Callao, Peru		1,346
Campeche, Mexico		1,210
Cape Engano, Luzon I., P. I.		8,965
Cape Haitien, Haiti		860
Cape San Lucas, Mexico		2,100
Carmen, Mexico		1,289
Cartagena, Colombia		324
Ceiba, Honduras		709
Charleston, S. C., U. S. A.	Via Windward and Crooked I. Passages	1,607
Chimbote, Peru		1,158
Christmas I., N. Pacific Ocean		4,752
Cienfuegos, Cuba		815
Colombo, Ceylon	Via San Bernardino Strait and Iloilo	12,087
Coquimbo, Chile		2,451
Corinto, Nicaragua		683
Coronel, Chile		2,822
Curacao (Santa Ana Harbor), W. I.		742
Dutch Harbor, Alaska		5,245
Enderbury I., Phoenix Is.		5,599
Esmeraldas, Ecuador		474
Fakarava, Tuamotu Archipelago		4,256
Fort De France, Martinique, W. I.		1,202
Funafuti I., Ellice Is.		6,217
Galapagos Is., San Cristobal I. (Wreck Bay).		864
Galveston, Tex., U. S. A.		1,536
Gibraltar	Via Anegada Passage	4,375
Do	Via St. Thomas, W. I.	4,386
Gracias a Dios, Nicaragua		442
Grijalva [Tabasco R.], Mexico		1,323
Guam (Port Apra), Marianas		7,988
Guantanamo Bay (Caimanera), Cuba		739
Guayaquil (Puna), Ecuador		793
Guaymas, Mexico		2,370
Gulfport, Miss., U. S. A.	Northbound	1,431
Habana, Cuba		1,046
Hakodate, Japan		7,418
Halifax, N. S.	Via Windward and Crooked I. Passages	2,360
Hamburg, Germany	Via Mona Passage, direct	5,113
Do	Via St. Thomas, W. I.	5,158
Hampton Roads (off light), Va., U. S. A.	Via Windward and Crooked I. Passages	1,811
Havre, France	Via Mona Passage	4,653
Hilo, Hawaii		4,527
Hongkong		9,195
Honolulu, Hawaii		4,685
Iquique, Chile		1,987
Iriona, Honduras		609
Jacksonville, Fla., U. S. A.	Via Windward and Crooked I. Passages	1,559
Jaluit, Marshall Is.		6,666
Johnson I., Hawaii		5,359
Junin, Chile		1,967

PANAMA ROADS—Continued

Panama Roads, C. Z., to—	Route—	Nautical Miles
Key West, Fla., U. S. A.		1,108
Kingston, Jamaica, W. I.		594
Kiska I., Alaska		5,819
Kusaie I. (Lollo Hbr.), Caroline Is.		7,059
La Guaira, Venezuela		884
La Union, Salvador		748
Levuka, Fiji Is.		6,288
Libertad Anch., Sonora, Mexico		2,534
Liverpool ,England	Via Mona Passage	4,591
Livingston, Guatemala		815
Los Angeles Hbr. (San Pedro), Cal., U. S. A.		2,913
Lota, Chile		2,825
Magdalena Bay, Mexico		2,265
Manila, P. I.	Via Cape San Lucas and Balingtang Channel.	9,347
Do	Via San Bernardino Strait	9,370
Marquesa Is., Nakuhiva (Taiohae)		3,826
Marshall Is. (Eniwetok Atoll)		7,041
Matagorda Bay (Entr.), Tex., U. S. A.		1,558
Mazatlan, Mexico		2,006
Mejillones Del Sur, Chile		2,109
Melbourne, Australia	Via Foveaux Strait	7,928
Midway Is. (Welles Hbr.)		5,707
Mobile, Ala., U. S. A.	Northbound	1,436
Mollendo, Peru		1,796
Monkey Pt. Hbr., Nicaragua		302
Montreal, Canada	Via Windward and Crooked I. Passages and Gut of Canso.	3,203
Naples, Italy	Via Anegada Passage	5,351
New Hebrides (St. Philip and St. James Bay).		6,956
New Orleans, La., U. S. A.	Via South Pass; northbound	1,446
Do	Via Southwest Pass; northbound	1,453
New York (The Battery), N. Y. U. S. A.	Via Windward and Crooked I. Passages	2,017
Newport News, Va., U. S. A.	do	1,819
Nonuti I., Gilbert Is.		6,439
Norfolk, Va., U. S. A.	Via Windward and Crooked I. Passages	1,822
Noumea, New Caledonia		6,982
Nukonono, Union Is.		5,688
Pacasmayo, Peru		1,040
Pago Pago, Samoa Is.		5,656
Paita, Peru		857
Pelew Is. (Korror Hbr.)		8,674
Pensacola, Fla., U. S. A.	Northbound	1,412
Philadelphia, Pa., U. S. A.	Via Windward and Crooked I. Passages	1,989
Pisagua, Chile		1,962
Pisco, Peru		1,458
Plymouth, England	Via St. Thomas, W. I.	4,543
Point a Pitre, Guadeloupe, W. I.		1,211
Ponape, Caroline Is.		7,321
Port Arthur, Tex., U. S. A.		1,528
Port au Prince, Haiti		817
Port Castries, S. Lucia, W. I.		1,203
Port Limon, Costa Rica		235
Port Lloyd, Ogasawara Is.		7,766
Port Morelos, Yucatan		871
Port Royal, Jamaica, W. I.		589
Port of Spain, Trinidad, W. I.		1,202
Port Taltal, Chile		2,225
Port Tampa, Fla., U. S. A.		1,255
Port Townsend, Wash., U. S. A.		3,985
Portland, Me., U. S. A.	Via Windward and Crooked I. Passages; outside Nantucket Lightvessel.	2,241
Portland, Ore., U. S. A.		3,869
Puerto Barrios, Guatemala		823
Puerto Cabello, Venezuela		845
Puerto Cortes, Honduras		776
Puerto Mexico, Mexico		1,420
Punta Arenas, Chile		3,943
Punta Arenas, Costa Rica		471
Quebec, Canada	Via Windward and Crooked I. Passages and Gut of Canso.	3,065
Raoul I. (East Anch.), Kermadec Is.		6,125
Rarotonga I. (Avarua Hbr.)		5,095
Rio de Janeiro, Brazil		4,392

PANAMA ROADS—Continued

Panama Roads, C. Z., to—	Route—	Nautical Miles
Rio Grande (Entr.)		1,527
Roatan I. (Coxen Hole)		684
Sabine, Tex., U. S. A.		1,519
St. Thomas, W. I.		1,072
Salina Cruz, Mexico		1,170
San Bernardino Strait (Entr.), P. I.		9,060
San Blas, Mexico		1,914
San Diego, Cal., U. S. A.		2,843
San Francisco, Cal., U. S. A.		3,245
San Jose, Guatemala		886
San Juan, P. R.		1,036
San Juan del Norte, Nicaragua		289
San Juan del Sur, Nicaragua		590
Santa Barbara, Cal., U. S. A.		2,980
Santo Domingo, Dominican Rep.		845
Savannah, Ga., U. S. A.	Via Windward and Crooked I. Passages	1,606
Seattle, Wash., U. S. A.		4,021
Shanghai, China	Via Honolulu	9,015
Do	Via Osumi (Van Diemen) Strait	8,650
Do	Via Tsugaru Strait	8,556
Singapore, Straits Settlements	Via San Bernardino Strait	10,505
Southport, N. C., U. S. A.	Via Windward and Crooked I. Passages	1,635
Strait of Gibraltar (lat. 35° 57′ N., long. 5° 45′ W.).	Via Anegada Passage	4,351
Sydney, Australia		7,674
Tacoma, Wash., U. S. A.		4,041
Tahiti (Papeete), Society Is.		4,486
Talcahuano, Chile		2,805
Tampico, Mexico		1,528
Tela, Honduras		719
Tocopilla, Chile		2,068
Tongatabu (Nukualofa), Tonga Is.		5,953
Trujillo, Honduras		665
Tuxpam, Mexico		1,498
Ugi I. (Selwyn Bay), Solomon Is.		7,248
Uracas I., Marianas		7,797
Valdivia (P. Corral), Chile		2,983
Valparaiso, Chile		2,616
Vancouver, B. C.		4,032
Vera Cruz, Mexico		1,463
Vladivostok, Siberia	Via Tsugaru Strait	7,833
Wellington, New Zealand		6,595
Yap I. (Tomill Hbr.), Caroline Is.		8,430
Yokohama, Japan	Via Cape San Lucas and G. C.	7,682
Do	Via Mazatlan	7,788
Do	Via San Francisco	7,781

PORT TOWNSEND

Port Townsend, Wash., U. S. A. to—	Route—	Nautical Miles
Amoy, China	Via Tsugaru Strait and Composite route.	5,450
Do	Via Osumi (Van Diemen) Strait and Composite route.	5,477
Do	Via Unimak Passage and Tsugaru St.	5,442
Do	Via Unimak Passage, Amphitrite Sts. and La Perouse.	5,434
Antwerp, Belgium	Via San Francisco and Panama Canal	8,866
Do	Via San Francisco and Magellan St.	14,391
Apia, Samoa Is.		4,577
Auckland, New Zealand		6,134
Baltimore, Maryland, U. S. A.	Via San Francisco and Panama Canal	5,959
Do	Via San Francisco and Magellan St.	13,979
Batavia, Java	Via Balintang Channel and Composite route.	7,323
Blanche Bay, Neu Pommern		5,462
Bordeaux, France	Via San Francisco and Panama Canal	8,656
Do	Via San Francisco and Magellan St.	14,032
Boston, Mass., U. S. A.	Via San Francisco and Panama Canal	6,215
Do	Via San Francisco and Magellan St	13,876
Calcutta, India	Via Rhumb to Yokohama	8,970
Canton, China	Via Osumi (Van Diemen) Strait and Composite route.	5,814
Do	Via Tsugaru St. and Composite route	5,792
Do	Via Unimak Passage and Tsugaru St.	5,764

PORT TOWNSEND—Continued

Port Townsend, Wash., U. S. A. to—	Route—	Nautical Miles
Cape Ergano, Luzon L., P. I.		5,515
Cebu, Cebu Island, P. I.		5,870
Charleston, S. C., U. S. A.	Via San Francisco and Panama Canal	5,622
Do	Via San Francisco and Magellan St.	13,856
Chefoo, China	Via Tsugaru St. and Composite route	5,102
Do	Via Unimak Passage and Tsugaru St.	5,074
Do	Via Osumi (Van Diemen) Strait	5,340
Do	Via Unimak Passage, Amphitrite and La Perouse.	5,084
Christmas Island, N. Pacific Ocean		3,344
Colombo, Ceylon	Via Balintang Channel, Malakka Sts. and Composite route.	8,616
Comox, B. C.	Via Active Passage	145
Dutch Harbor, Unalaska I., Alaska		1,670
Enderbury I., Phoenix Is.		4,012
Fakarava I., Tuamotu Archipelago		4,120
Foochow, China	Via Osumi (Van Diemen) Strait and Composite route.	5,364
Do	Via Tsugaru St. and Composite route	5,328
Do	Via Unimak Passage and Tsugaru St.	5,300
Do	Via Unimak Passage, Amphitrite Sts. and La Perouse.	5,313
Funafuti I., Ellice Is.		4,692
Galapagos Is., San Cristobol I. (Wreck Bay.)		3,734
Galveston, Texas	Via San Francisco and Panama Canal	5,551
Do	Via San Francisco and Magellan St.	14,497
Gibraltar	Via San Francisco, Panama Canal and Anegada Passage.	8,390
Do	Via San Francisco and Magellan St.	13,341
Guam (Port Apra) Marianas		4,913
Hakodate, Japan	Composite	3,915
Do	Via Unimak Passage	3,887
Hamburg, Germany	Via San Francisco, Panama and Mona Passage.	9,128
Do	Via San Francisco and Magellan St.	14,653
Hongkong	Via Osummi (Van Diemen) St. and Composite route.	5,731
Do	Via Rhumb to Yokohama	5,992
Do	Via Tsugaru Strait and Composite	5,709
Do	Via Unimak Passage and Tsugaru St.	5,681
Honolulu, Hawaii		2,366
Iloilo, P. I.		5,892
Jacksonville, Florida, U. S. A.	Via San Francisco and Panama Canal	5,574
Do	Via San Francisco and Magellan St.	13,875
Jaluit, Marshall Is.		4,259
Jinsen (Chemulpo),	Via Unimak Passage, Amphitrite Sts. and La Perouse.	4,977
Do	Via Unimak Passage and Tsugaru St.	4,967
Do	Via Tsugaru St. and Composite route	4,995
Do	Via Osumi (Van Diemen) Strait	5,242
Johnson Island, Hawaii		2,978
Kiska I. (Kiska Hbr), Alaska	Via Unimak Passage	2,257
Kobe, Japan	Composite	4,500
Kodiak, Alaska		1,229
Kusaie I. (Lollo Hbr.), Caroline Is.		4,542
Levuka, Fiji Is.		5,083
Liverpool, England	Via San Francisco and Panama Canal	8,606
Do	Via San Francisco and Magellan St.	14,272
Manila, P. I.	Composite Great Circle	5,931
Marquesas Is., Nukuhiva (Taiohae)		3,628
Marshall Islands (Eniwetok Atoll)		4,315
Mobile, Alabama, U. S. A.	Via San Francisco and Panama Canal	5,429
Do	Via San Francisco and Magellan St.	14,268
Nagasaki, Japan	Via Tsugaru St. and Composite	4,700
Do	Via Osumi (Van Diemen) St. and Composite.	4,832
New Hebrides (St. Philip and St. James Bay.)		5,344
New Orleans, La., U. S. A.	Via San Francisco, Panama and Southwest Pass.	5,457
Do	Via San Francisco, Magellan St. and South Pass.	14,321
New York, N. Y., U. S. A.	Via Panama Canal	6,002
Do	Via Magellan St.	13,873
Nonuti Island, Gilbert Islands		4,395

PORT TOWNSEND—Continued

Port Townsend, Wash., U.S.A., to—	Route	Nautical Miles
Norfolk, Va., U. S. A.	Via San Francisco and Panama Canal	5,837
Do	Via San Francisco and Magellan St.	13,857
Noumea, New Caledonia		5,729
Nukonono, Union Is.		4,345
Panama Road, C. Z.		3,985
Pelew Is. (Korror Hbr.)		5,587
Pensacola, Florida, U. S. A.	Via San Francisco and Panama	5,402
Do	Via San Francisco and Magellan St.	14,288
Petropavlovsk, Kamchatka	Via Unimak Passage	2,905
Philadelphia, Pa., U. S. A.	Via San Francisco and Panama Canal	6,004
Do	San Francisco and Magellan St.	13,952
Port Lloyd, Ogasawara Is.		4,416
Port Tampa, Florida, U. S. A.	Via San Francisco and Panama Canal	5,270
Do	Via San Francisco and Magellan St.	14,023
Portland, Maine, U. S. A.	Via San Francisco and Panama Canal	6,256
Do	Via San Francisco and Magellan St.	13,907
Punta Arenas, Chile		6,931
Raoul Island (East Anch.), Kermadee Islands.		5,547
Rarotonga I. (Avarua Hbr.), Cook Is.		4,665
Ryojun (Port Arthur), Kwangtung, Manchuria.	Via Tsugaru St. and Composite route	5,143
Do	Via Unimak Passage and Tsugaru St.	5,115
Do	Via Unimak Passage, Amphitrite Sts. and La Perouse.	5,125
Do	Via Osumi (Van Diemen) St.	5,381
San Bernardino Strait (Entr.), P. I.		5,714
San Francisco, Cal., U. S. A.		770
Savannah, Georgia, U. S. A.	Via San Francisco and Panama Canal	5,621
Do	Via San Francisco and Magellan St.	12,888
Seattle, Wash.		28
Shanghai, China	Via Unimak Passage, Amphitrite Sts. and La Perouse.	5,035
Do	Via Osumi (Van Diemen) St. and Composite.	5,186
Do	Via Tsugaru St. and Composite	5,053
Do	Via Unimak Passage and Tsugaru St.	5,025
Shimonoseki, Japan	Via Composite route from Yokohama and Bungo Channel.	4,689
Do	Via Tsugaru St. and Composite route	4,583
Singapore, Straits Settlements	Via Composite route and Balintang Channel.	7,034
Sitka, Alaska	Via Juan de Fuca Strait and outside	772
Swatow, China	Via Composite route and Osumi (Van Diemen) St.	5,581
Do	Via Composite route and Tsugaru St.	5,559
Do	Via Unimak Passage and Tsugaru St.	5,531
Tahiti (Papeete), Society Islands		4,260
Taku, China	Via Unimak Passage, Amphitrite Sts. and La Perouse.	5,278
Do	Via Osumi (Van Diemen) St.	5,534
Do	Via Composite route and Tsugaru St.	5,296
Do	Via Unimak Passage and Tsugaru St.	5,268
Tansui Harbor, Taiwan (Formosa)	Via Unimak Passage, Amphitrite St. and La Perouse.	5,272
Do	Via Osumi (Van Diemen) St. and Composite.	5,292
Do	Via Composite and Tsugaru St.	5,283
Do	Via Unimak Passage and Tsugaru St.	5,255
Ugi I. (Selwyn Bay), Solomon Is.		5,310
Uracas I., Marianas		4,585
Vancouver, B. C.		95
Victoria, Vancouver Island, B. C.		35
Vladivostok, Siberia	Via Akutan Passage and Tsugaru St.	4,300
Do	Via Unimak Passage, Amphitrite Sts. adn La Perouse.	4,183
Do	Via Composite route and Tsugaru St.	4,330
Do	Via Unimak Passage and Tsugaru St.	4,302
Weihaiwei, China	Via Unimak Passage and Tsugaru St. and La Perouse.	5,050
Do	Via Osumi (Van Diemen) St.	5,306
Do	Via Composite route and Tsugaru St.	5,068
Do	Via Unimak Passage and Tsugaru St.	5,040
Yap I. (Tomill Hbr.), Caroline Is.		5,346
Yokohama, Japan	Composite; south of Aleutian Islands	4,218
Do	Via Rhumb	4,469

SAN DIEGO

San Diego, Cal., U. S. A., to—	Route—	Nautical Miles
Acapulco, Mexico		1,431
Antofagasta, Chile		4,360
Arica, Chile		4,149
Caldera, Chile		4,492
Callao, Peru		3,585
Chimbote, Peru		3,402
Coquimbo, Chile		4,605
Corinto, Nicaragua		2,211
Esmeraldas, Ecuador		2,940
Guayaquil (Puna), Ecuador		3,112
Guaymas, Mexico		1,088
Hilo, Hawaii		2,175
Iquique, Chile		4,218
Los Angeles Harbor, Cal., U. S. A.		92
Lota, Chile		4,881
Magdalena Bay, Mexico		600
Mazatlan, Mexico		939
Midway Is. (Welles Harbor)		3,097
Mollendo, Peru		4,024
Pacasmayo, Peru		3,286
Paita, Peru		3,121
Panama, C. Z.		2,843
Pisco, Peru		3,695
Portland, Ore., U. S. A.		1,073
Punta Arenas, Chile		5,801
Punta Arenas, Costa Rica		2,429
Salina Cruz, Mexico		1,733
San Blas, Mexico		1,015
San Jose, Guatemala		1,993
Talcahuano, Chile		4,869
Valdivia (Port Corral), Chile		5,007
Valparaiso, Chile		4,738

SAN FRANCISCO

San Francisco, Cal., U. S. A., to—	Route—	Nautical Miles
Acapulco, Mexico		1,883
Amapala, Honduras		2,586
Amoy, China	Via Osumi (Van Dieman) Strait	5,796
Anchorage, Cook Inlet, Alaska		1,872
Antofagasta, Chile		4,762
Antwerp, Belgium	Via Panama Canal	8,096
Apia, Samoa Is.		4,161
Arica, Chile		4,551
Auckland, New Zealand		5,680
Baltimore, Md., U. S. A.	Via Panama Canal	5,189
Batavia, Java	Via Balintang Channel	7,642
Bishop's Rock (lat. 49° 50′ N., long. 6° 27′ W.)	Via Panama Canal and Mona Passage	7,6[illegible]4
Blanche Bay, New Pommern		5,396
Bordeaux, France	Via Panama Canal	7,886
Do	Via Magellan Strait	13,262
Boston, Mass., U. S. A.	Via Panama Canal	5,445
Bremen, Germany	do	8,3[illegible]
Bremerton, Wash.		81

SAN FRANCISCO—Continued

San Francisco, Cal., U. S. A., to—	Route	Nautical Miles
Brest, France	Via Magellan and Rio de Janeiro	13,271
Do	Via Panama and Mona Passage	7,708
Buenos Aires	Via Panama Canal	8,738
Do	Via Magellan Strait	7,576
Caldera, Chile		4,894
Caleta Buena (Buena Cove), Chile		4,608
Callao, Peru		3,987
Canton, China	Via Osumi (Van Diemen) Strait	6,132
Cape Ergano, Luzon L., P. I.		5,840
Cape Wrangell, Attu I., Alaska		2,798
Cebu, Cebu Island, P. I.		6,146
Charleston, S. C., U. S. A.	Via Panama Canal	4,852
Chefoo, China	Via Tsugaru Strait	5,436
Do	Via Osumi (Van Diemen) Strait	5,659
Chimbote, Peru		3,804
Christmas Island, N. Pacific Ocean		2,894
Colombo, Ceylon	Via Balintang Channel and Malakka Strait.	8,935
Copenhagen, Denmark	Via Panama and Mona Passage	8,638
Coquimbo, Chile		5,007
Corinto, Nicaragua		2,613
Dutch Harbor, Alaska	Via Sitka	2,386
Enderbury I., Phoenix Is.		3,657
Esmeraldas, Ecuador		3,342
Fakarava I., Tuamoto Archipelago		3,503
Flavel, Oregon		561
Foochow, China	Via Osumi (Van Diemen) Strait	5,683
Funafuti I., Ellice Is.		4,295
Galapogos Is., San Cristobal I., (Wreck Bay.)		2,994
Galveston, Texas	Via Panama Canal	4,781
Do	Via Magellan Strait	13,727
Gibraltar	Via Panama Canal and Anegada Passage.	7,620
Guam (Port Apra) Marianas		5,053
Guayaquil (Puna) Ecuador		3,514
Guaymas, Mexico		1,490
Gulf of Fonseca (Moneypenny Pt.), Nicaragua.		2,587
Habana, Cuba	Via Panama Canal	4,291
Hakodate, Japan		4,249
Halifax, N. S.	Via Panama Canal	5,605
Hamburg, Germany	Via Panama Canal	8,358
Havre, France	do	7,898
Hongkong		6,306
Honolulu, Hawaii		2,091
Iloilo, P. I.		6,168
Iquique, Chile		4,629
Jacksonville, Fla.	Via Panama Canal	4,804
Jaluit, Marshall Is.		4,150
Jinsen (Chemulpo), Chosen (Korea)	Via Osumi (Van Diemen) Strait	5,561
Johnson Island, Hawaii		2,779
Junin, Chile		4,598
Key West, Fla.	Via Panama Canal	4,353
Kiska I., Alaska		2,629
Kusaie I., (Lollo), Caroline Is.		4,478
La Union, Salvador		2,586
Levuka, Fiji Is.		4,705
Libertad Anch., Sonora, Mexico		1,648
Liverpool, England	Via Panama Canal	7,836
Do	Via Magellan Strait	13,502

SAN FRANCISCO—Continued

San Francisco, Cal., U. S. A., to—	Route	Nautical Miles
London, England	Via Panama Canal and Mona Passage	8,051
Los Angeles Harbor (San Pedro)		368
Lota, Chile		5,282
Magdalena Bay, Mexico		1,002
Manila, P. I.	Via Balintang Channel	6,221
Do	Via San Bernardino Strait	6,301
Do	Via Honolulu and north end of Luzon, P. I.	6,960
Do	Via Honolulu, Guam and north end of Luzon, P. I.	7,170
Do	Via Honolulu, Guam and San Bernardino Strait.	6,929
Do	Via Honolulu, Yokohama and Balintang Channel.	7,242
Do	Via Yokohama and Balintang Channel	6,293
Do	Via Yokohama, Osumi (Van Diemen) Strait and Hongkong.	6,752
Do	Via Yokohama, Inland Sea, and Nagasaki.	6,575
Do	Via Yokohama, Osumi (Van Diemen) Strait and Nagasaki.	6,522
Do	Via Osumi (Van Diemen) Strait and Nagasaki.	6,457
Mare I., (Navy Yard), Cal., U. S. A.		23
Muquesas Is., Nukuhiva (Taiohae)		2,987
Marshal Islands (Eniwetok Atoll)		4,306
Mazatlan, Mexico		1,337
Mejillones del Sur, Chile		4,734
Midway Is., (Welles Hrabor)		2,792
Mobile, Alabama, U. S. A.	Via Panama Canal	4,659
Do	Via Magellan Strait	13,498
Mollendo, Peru		4,426
Monterey, Cal., U. S. A.		95
Nagasaki, Japan	Via Yokohama and Inland Sea	5,269
Naples, Italy	Via Panama Canal	8,596
New Hebrides (St. Philip and St. James Bay.)		5,086
New Orleans., La., U. S. A.	Via Panama Canal and South Pass	4,691
Do	Via Panama Canal and Southwest Pass	4,698
New York (The Battery), N. Y., U. S. A.	Via Cape Horn	13,328
Do	Via Magellan Strait	13,135
Do	Via Panama Canal	5,262
Newcastle, Australia		6,467
Newport News, Va., U. S. A.	Via Panama Canal	5,064
Nonuti Island, Gilbert Islands		4,185
Norfolk Va., U. S. A.	Via Panama Canal	5,067
Noumea, New Caledonia		5,410
Nukonono, Union Is.		3,957
Pacasmayo, Peru		3,688
Pago Pago, Samoa Is.		4,150
Paita, Peru		3,523
Panama, C. Z.		3,245
Paramaribo, Guiana	Via Panama Canal	4,936
Pelew Is. (Korror Hbr.)		5,751
Pensacola, Fla., U. S. A.	Via Panama Canal	4,632
Do	Via Magellan Strait	13,458
Petropavlovsk, Kamchatka	Via Unimak Passage	3,292
Philadelphia, Pa., U. S. A.	Via Panama Canal	5,234
Pichilinque, Mexico		1,300
Pisagua, Chile		4,593
Pisco, Peru		4,097
Plymouth, England	Via Panama and Mona Passage	7,788
Pola, Austria	Via Panama and Anegada Passage	9,255
Do	Via Magellan Strait and Rio de Janeiro	14,323
Ponape, Caroline Is.		4,641
Port Lloyd, Ogasawara Is.		4,675
Port Taltal, Chile		4,838
Port Tampa, Fla., U. S. A.	Via Panama Canal	4,590
Do	Via Magellan Strait	13,253
Portsmouth, England	Via Panama Canal	7,875
Do	Via Magellan Strait and Rio de Janeiro	13,471

SAN FRANCISCO—Continued

San Francisco, Cal., U. S. A., to—	Route	Nautical Miles
Port Townsend, Wash., U. S. A.		770
Portland, Maine, U. S. A.	Via Panama Canal	5,486
Portland, Oregon, U S A		650
Punta Arenas, Chile		6,193
Punta Arenas, Costa Rica		2,831
Raoul Island, (East Anch.), Kermadec Islands.		5,090
Rarotonga I., (Avarua Hbr.), Cook Is.		4,124
Rio de Janeiro, Brazil	Via Panama Canal	7,637
Do	Via Magellan Strait	8,430
Ryojun (Port Arthur), Kwangtung, Manchuria.	Via Osumi (Van Diemen) Strait	5,700
St. Paul, Pribilof Is., Alaska	Via Dutch Harbor	2,289
Salina Cruz, Mexico		2,135
San Bernardino Strait (Entr.), P. I.		5,991
San Blas, Mexico		1,417
San Diego, Cal., U. S. A.		452
San Jose, Guatamala		2,395
San Juan, P. R.	Via Panama Canal	4,281
Santa Barbara, Cal., U. S. A.		288
Sasebo, Japan	Via Osumi (Van Diemen) Strait	5,185
Savannah, Georgia, U. S. A.	Via Panama Canal	4,851
Seattle, Wash., U. S. A.		804
Sevastopol, Russia	Via Panama and Anegada Passage	9,738
Shanghai, China	Via Osumi (Van Diemen) Strait	5,505
Shimonoseki, Japan	Via Bungo Channel and Osumi (Van Diemen) Strait.	5,008
Do	Via Tsugaru Strait	4,916
Singapore, Straits Settlement	Via Balintang Channel	7,353
Sitka, Alaska		1,302
Southampton, England	Via Panama Canal	7,863
Spezia, Italy	Via Panama and Anegada Passage	8,496
Do	Via Magellan Strait and Rio de Janeiro	13,564
Stockholm, Sweden	Via Panama Canal	9,185
Swatow, China	Via Osumi (Van Diemen) Strait	5,900
Sydney, Australia	Via Honolulu, Pago Pago, and Auckland.	7,212
Do	Via Honolulu and Pago Pago	6,744
Tacoma, Wash., U. S. A.		826
Taku, China	Via Osumi (Van Diemen) Strait	5,853
Do	Via Tsugaru Strait	5,630
Talcahuano, Chile		5,270
Tansui Harbor, Taiwan (Formosa)	Via Osumi (Van Diemen) Strait	5,611
Do	Via Tsugaru Strait	5,617
Tientsin, China	Via Yokohama, Bungo Channel and north of Quelpart I.	5,918
Tocopilla, Chile		4,699
Tongatabu (Nukualofa) Tonga Is.		4,628
Ugi I., (Selwyn Bay), Solomon Is.		5,129
Uracas I., Marianas		4,779
Valdivia (Port Corral), Chile		5,407
Valparaiso, Chile		5,140
Vera Cruz, Mexico	Via Panama	4,798
Vladivostok, Siberia	Via Unimak Passage, Amphitrite St.	4,570
Do	Tsugaru Strait	4,664
Weihaiwei, China	Via Tsugaru Strait	5,402
Do	Via Osumi (Van Diemen) Strait	5,625
Wellington, New Zealand		5,905
Wilhelmshaven, Germany	Via Panama and Mona Passage	8,294
Do	Via Magellan and Rio de Janeiro	13,883
Wilmington, N. C., U. S. A.	Via Panama Canal	4,901
Yap I. (Tomill Hbr.), Caroline Is.		5,501
Yokohama, Japan	Great Circle	4,536
Do	Rhumb	4,799

SAN FRANCISCO

DISTANCES FROM SAN FRANCISCO, CAL., U. S. A., TO DOMESTIC, MEXICAN AND BRITISH COLUMBIA PORTS AND COAST POINTS

	Nautical Miles
Anacortes, Wash.	796
Anchorage, Alaska	1872
Astoria, Oregon	555
Bellingham, Wash.	810
Bodega Head	51
Bolinas	16
Bremerton, Wash.	815
Cape Arago	372
Cape Blanco	341
Cape Disappointment	545
Cape Flattery, Wash.	680
Cape Fortuna	200
Cape Foulweather	464
Cape Lookout	486
Cape Mendocino	195
Cape Perpetua	433
Cape San Martin	147
Cape St. George	276
Carpenteria	312
Cayucos	193
Columbia River Bar	540
Coos Bay	375
Coquille River	360
Crescent City	274
Destruction Island	634
Douglas Island	1593
Dutch Harbor	2051
Dutch Harbor via Sitka	2386
Onsenada	496
Eureka (Humboldt Bay)	216
Everett, Wash.	797
False Tillamook	511
Flattery Rocks	667
Flavel, Oregon	561
Gaviota	275
Goleta	296
Grays Harbor	558
Guaymas, Mexico	1490
Hueneme	337
Humboldt Bay	216
Juneau, Alaska	1596
Killisnoo	1299
Kiska Island, Alaska	2629
Klawak	1472
Kotzebue Sound	2927
Ladysmith, B. C.	804
La Paz	1722
Lompoc Landing	241
Loring	1381
Los Angeles Harbor	368
Magdalena Bay	1002
Mazatlan	1478
Mendocino	123
Monterey	93
Moro Bay	198
Nanaimo, B. C.	828
Newport	411
New Westminster, B. C.	829
Nome, Alaska	2705
Olympia, Wash.	862
Pigeon Point	45
Pillar Point	26
Point Arena	100
Point Arguello	252
Point Bonita	7
Point Buchon	206
Point Conception	263
Point Cypress	100
Point Duma	360
Point Fermin	391
Point Gorda	184
Point Lobos	7½
Point Loma	475
Point New Year	50
Point Pedro	19
Point Piedras Blancas	166
Point Reyes	33
Point Sal	232
Point San Luis	215
Point Sur	115
Point Tomales	46
Point Vincent	384
Port Clarence	2723
Portland, Oregon	650
Port Orford	336
Port San Luis	216
Port Townsend	770
Powell River, B. C.	868
Redondo	379
Rogue River	313
San Diego	482
San Jose del Cabo	1192
San Luis Obispo	226
San Simeon	172
Santa Barbara	288
Santa Cruz	71
Santa Monica	372
San Pedro	393
Santa Rosalia	1895
Seattle, Wash.	864
Shelter Cove	165
Shoalwater Bay	569
Sitka, Alaska	1302
St. Michael	2705
Table Bluff	212
Tacoma, Wash.	826
Tillamook Bay	499
Tillamook Head	523
Trinidad	233
Umpqua River	394
Unalaska	2051
Union Bay, B. C.	875
Vancouver, B. C.	833
Ventura	327
Victoria, B. C.	750
Willapa Hbr. "Whistle Buoy"	588
Wrangel, Alaska	1448
Yakuina Bay	454

WILLAPA HARBOR

Willapa Harbor Wash. "Whistle Buoy" to—	Route—	Nautical Miles
Astoria, Oregon		38
Eureka, Humboldt Bay		355
Grays Harbor, "Whistle Buoy"		15½
Honolulu, Hawaii		2,268
Los Angeles Harbor (San Pedro) Cal.		956
Manila, P. I.	Via Honolulu	7,035
Port Townsend, Wash.		194
San Francisco		588
Seattle, Wash.		233
Tacoma, Wash.		258
Vancouver, B. C.		254
Victoria, B. C.		170

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