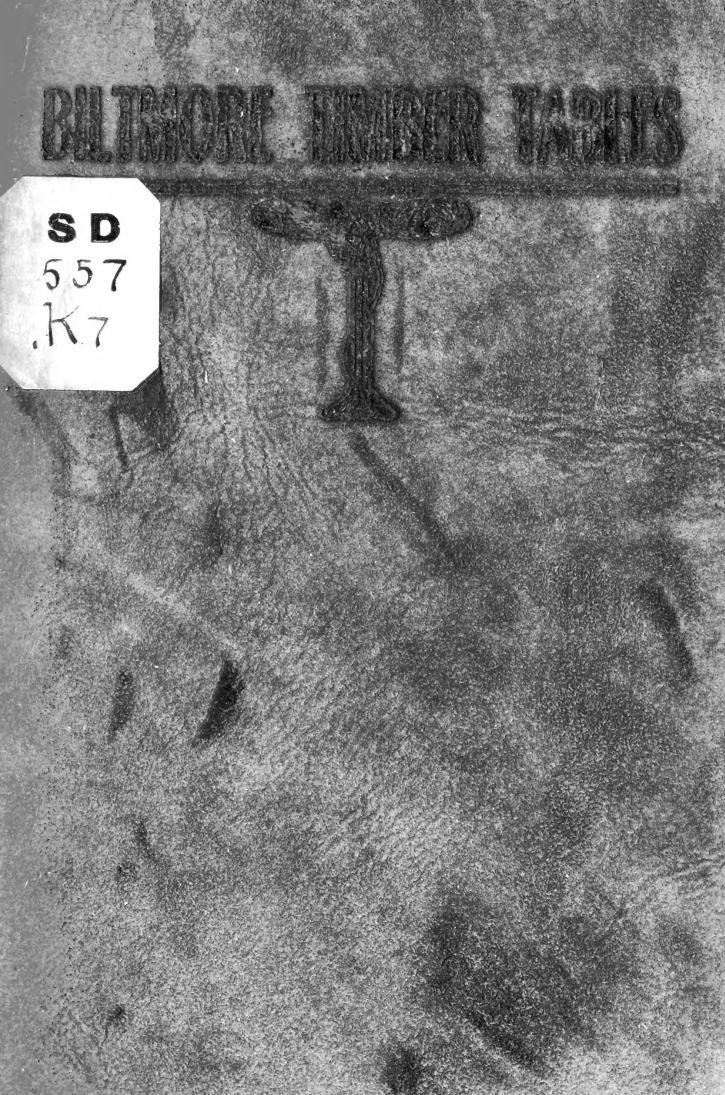
BILTMORE TIMBER YARDS



1 p increment

2 pe increment

5 pe increment

8 1-6

Volumes have been written on volume

but

little has been written on

quality and price

Biltmore Timber Tables

BY

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FOR THE USE OF THE

BILTMORE FOREST SCHOOL

WORKING FIELDS, 1911-12:

ADIRONDACKS, SOUTHERN APPALACHIANS, LAKE STATES, PACIFIC COAST AND GERMANY

INTRODUCTION

This booklet has been prepared for the use of the students of the Biltmore Forest School and may prove of interest to foresters and lumbermen in general.

The original material consists of Compound Interest Keys for solving financial problems, Keys for the mental calculation of areas of circles, and Form Height Factors for estimating standing timber in board feet of lumber and in cords of wood and bark.

The Mill Factor Method of estimating standing timber is employed by Dr. C. A. Schenck, who publishes a handy booklet of Cruiser's Tables giving contents in board feet for trees of any diameter, any number of logs up to 6, any taper per log from I inch to 4 inches, and any Mill Factor from 5 to 8.

The Volume Tables of "The Woodman's Handbook" have been used as a basis for working out Form Height Factors.

The Tables for Use in Germany were compiled during an excursion through the forests of Germany.

This booklet is the right size for inserting in "The Woodman's Handbook" by Henry S. Graves, published by The United States Forest Service, or in "A Manual for Northern Woodsmen" by Austin Cary, published by Harvard University.

PROBLEMS IN FOREST FINANCE

To Illustrate the Utility of the Compound Interest Keys

1. The Report on the Standing Timber of the United States by Herbert Knox Smith, commissioner of corporations, gives as examples of "enormous increase in value with great profits to the owners" during an interval of 40 years: From $5 to $30 an acre, $7 to $40, $20 to $150, $1 to $13, $4 to $140, $1 to $50.

Question: What rate of interest do these "great profits" represent?

2. Southern pine sold by the government 40 years ago at $1.25 per acre is now worth $60. Douglas Fir sold at $2.50 is now worth $100 to $200. What has been the annual price increment?

3. If Yellow Poplar log run averaged $14 in 1895 and $30 in 1910, what has been the annual increase in stumpage value, assuming that the expense of production was $10?

4 Timber worth $8 per acre in 1906 has increased yearly in volume 1 per cent, quality increment $2\frac{1}{2}$ per cent, price increment $4\frac{1}{2}$ per cent. Value in 1911?

5. If stumpage prices increase 8 per cent. yearly, when will the investment double? When will investment increase threefold? Tenfold?

6. In 1911 White Pine stumpage is worth $6 per M, Poplar $5, Oak $4, and Yellow Pine $3. What were the prices in 1890 and in 1900 if the annual price increment has been 10 per cent for White Pine, 8 per cent for Poplar and Oak, and 12 per cent. for Yellow Pine?

PROBLEMS

7. In 1901, $1200 was paid for marked trees, equal volumes of White Pine, Poplar and Oak. The trees were to be cut in 5 years but in 1906 $700 was borrowed at 6 per cent. to pay for the privilege of letting the timber stand until 1911. How much was gained (or lost) by waiting until 1911? The annual increments in volume, quality, and price were: White Pine, 3½ per cent, 3 per cent, 8 per cent; Poplar 3 4-5, 2, 9; Oak 1 4-5, 1, 6.

8. In 1900 a forest of 10,000 acres was bought for $70,000. Taxes in 1900 were 6 cents per acre and advanced gradually to 15 cents in 1910. The lumber cut in 1900 was 1000 M and increased steadily each year to 2000 M in 1910. Stumpage netted $2 per M in 1900 and rose steadily to $5 in 1910. In 1904, a right of way was sold for $150; in 1905, a waterpower site brought $2500; in 1906, mineral rights, $3800; in 1907, tan bark $2750 net; in 1908, extract wood, $1320 net.

In 1910, the property was sold for $20,000 cash, $10,000 yearly for 5 years, and shares of U. S. Steel, some common at 77⅞ and the rest preferred at 119. Question: How many shares of each were secured to make 7 per cent. on investment, including taxes?

ANSWERS

1. $5 to $30=Aft-Value 6. Key 184. 184÷40=4.6 per cent. (Case 3.)

Similarly, the other rates of interest are 4.5 per cent, 5.2 per cent, 6.6, 9.1, and 10.1 per cent.

2. $1.25 to $60=Aft-Value 48. Key 397. 397÷40=10 per cent.
   $2.50 to $100=Aft-Value 40. Key 378. 378÷40=9½ per cent.
   $2.50 to $200=Aft-Value 80, Key 449. 449÷40=11.2 per cent.
   (Case 3)
3. $4 to $20=Aft-Value 5. Key 165. 165÷15=11 per cent. (Case 3.)
4. 8 1-5 per cent.×5 years=Key 41. Aft-Value 1.5. 1.5×$8=$12. (Case 1.)
5. Aft-Value 2=Key 71. 71÷8=9 years. (Case 4)
6. Case 2. 7. Case 1. 8. Case 1, 5 and 6.

COMPOUND INTEREST KEYS

(Aft-Value is value at the end; Pre-Value is value at the beginning)

AFT-VALUE	TENTHS									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	KEYS (Number of Years x Rate of Interest) KEYS									
1		10	19	27	34	41	48	54	60	66
2	71	76	81	85	90	94	98	102	106	109
3	113	116	119	122	125	128	131	134	137	140
4	142	145	147	150	152	154	157	159	161	163
5	165	167	169	171	173	175	177	179	180	182
6	184	186	187	189	190	192	193	195	196	198
7	199	200	202	203	205	206	208	209	210	211
8	213	214	215	217	218	219	220	221	223	224
9	225	226	227	228	229	231	232	233	234	235
10	236									
11	246									
12	255									
13	262									
14	270									
15	278									
16	284									
17	288									
18	296									
19	301									
20	307									
25	330									
50	401									
100	472									
500	637									
1,000	708									
10,000	944									
100,000	1180									

To obtain key of any omitted Aft-Value, add the keys of its factors. For example:

Key of 29=Key of 10 plus Key of 2.9=345.
Key of 36=Key of 6 plus Key of 6 =368.

Many problems may be solved mentally by remembering the Key for doubling, 71.

HOW TO USE THE KEYS:

CASE	GIVEN	WANTED	SOLUTION
1	per cent. and years	Aft-Value	per cent. x years=Key to Aft-V.
2	per cent. and years	Pre-Value	1 − Key to Aft-V.=Pre-Value
3	Aft-Value and "	per cent.	Key ÷ years=per cent.
4	per cent. & Aft-V.	Years	Key ÷ per cent.=years.
5	per cent. and years	Aft-Value of $1 paid yearly	$\frac{\text{Aft-Value of Key}-1}{\text{per cent.}}$
6	per cent. and years	Pre-Value of $1 paid yearly	$\frac{\text{Aft-Value of Key}-1}{\text{per cent. x Aft-Value of Key}}$

MILL FACTORS

The Mill Factor of a saw mill is its productive efficiency expressed in board feet of saw cut per cubic foot in the log. For example, Mill Factor 7 indicates that the mill produces 7 and wastes 5 board feet for each cubic foot in the log.

The unavoidable waste depends upon the following factors: soundness of logs, taper of logs, diameter of logs, thickness of saw, thickness of boards, smallest width permissible, quality ofmill machinery, skill of sawyer, inspection rules followed in edging and trimming, lowest marketable grade, and shrinkage.

Under the most favorable conditions, in the case of straight, sound logs, a band mill will have a Mill Factor of 8, while a circular mill will generally be rated not higher than 7.

The 40 or 50 different log rules used in the United States represent either constant or variable Mill Factors. Among the former are:

The N. Hampshire or Blodgett Rule (115 Blodgett Feet per M)—Mill Factor 6.
The Square of Two-thirds Rule " " 6.8
The Vermont Rule " " 7.6
The Square of Three-fourths Rule " " 8.6

The most common log rules with variable Mill Factors are:

Diameter	Doyle Rule	Scribner Rule	Maine Rule
	Mill Factor	Mill Factor	Mill Factor
6	1.3	6.1	6.1
9	3.6	5.7	7.2
12	5.2	6.3	8.3
15	6.2	7.3	8.2
18	6.9	7.4	8.2
21	7.6	7.9	8.7
24	8.0	8.0	8.7
30	8.6	8.4	9.0
36	9	8.2	9.1
40	9.2	8.6	9.0
50	9.7	8.6	
60	10.0	8.6	
120	10.7	8.8	

It is evident that any given log rule is accurate for any given saw mill only where the Mill Factor of the log rule equals the Mill Factor of the saw mill.

A standard method of log measurement would be to allow a certain number of board feet per cubic foot in the log. By comparing the solid cubic contents of a number of logs with the actual output in board feet of lumber, the Mill Factor of a mill is readily obtained.

Page 8 shows the contents of sound trees in feet board measure by the Mill Factor Method.

DOYLE BOARD FEET IN SOUND TREES

(Taper above butt log=$\frac{3}{4}$ to 3 inches)

Diameter Breast-High Outside Bark	Taper and Bark of Butt Log	No. of Fourteen Foot Logs			
		1	2	3	4
12	2.7	25	44	53	63
15	3.4	51	92	117	127
18	3.8	92	165	217	260
21	4	146	260	357	435
24	4.5	211	387	541	669
27	4.5	297	549	773	963
30	4.6	400	745	1050	1310
33	5	506	946	1340	1660
36	5.1	630	1190	1660	2060
39	5.6	754	1410	1980	2510
42	6.1	890	1670	2350	2970
45	6.6	1030	1950	2740	3470
48	7.1	1190	2250	3170	3990
51	7.7	1350	2550	3620	4540
54	8	1540	2890	4080	5080
57	8.8	1710	3220	4540	5650
60	9.2	1920	3560	5010	6250

The lumberman wastes timber to save money; the consumer wishes him to waste money to save timber.

CONTENTS OF SCUND TREES IN BOARD FEET
MILL FACTOR 7

(Taper above butt log=two inches per log)

Small Diameter of Butt Log Inside Bark	Number of Fourteen Foot Logs					
	1	2	3	4	5	6
7	26	39				
8	34	53				
9	43	69	83			
10	53	88	107			
11	65	108	134	147		
12	77	130	164	184		
13	90	155	198	224	238	
14	105	182	235	269	288	
15	112	210	275	318	344	
16	137	241	318	372	406	
17	154	275	365	430	473	
18	173	310	415	492	545	
19	193	347	468	558	623	
20	214	387	524	629	706	
21	236	428	583	703	794	
22	259	472	645	782	887	
23	283	518	711	866	986	
24	308	566	780	953	1090	
30	480	896	1260	1568	1827	
36	686	1309	1855	2338	2758	
42	938	1792	2569	3262	3878	
48	1225	2359	3395	4340	5194	5964
54	1554	3003	4340	5572	6699	7735
60	1918	3717	5397	6951	8400	9737

KEYS FOR MENTAL CALCULATION OF AREA OF CIRCLES

DIAMETER CLASS	BASE	KEY
6 inches to 12 inches	6 inches = .2 sq. ft.	.1 sq. ft. per in.
12 " " 24 "	12 " = .78 "	.2 " " " "
24 " " 36 "	24 " = 3.14 "	.3 " " " "
36 " " 40½ "	36 " = 7 "	.4 " " " "
40½ " " 50 "	40½ " = 9 "	.5 " " " "
50 " " 60 "	50 " = 13.6 "	.6 " " " "

The key to Square Feet Per Inch is the tens figure of the upper limit of the diameter class.

How to use the Keys:

$$\text{Area } 27 \text{ in.} = 3.14 + (\overline{27-24} \times .3) = 4.0 \text{ sq. ft.}$$

$$\text{Area } 38 \text{ in.} = 7 + (\overline{38-36} \times .4) = 7.8 \text{ sq. ft.}$$

ESTIMATING STANDING TIMBER AT SIGHT

After the Keys for Area of Circles are memorized, standing timber may be estimated at sight quickly and accurately by the Sectional Area—Form Height Factor Method af follows:

No. OF 14 ft LOGS (Taperabovebutt log equals 2 in. per log.)	COTTENTS OF SOUND TREES IN BOARD FFET, MILL FACTOR 7
1	Area of small end of butt log inside bark x 100
2	Contents of a one log tree x 1¾
3	" x 2½
4	" x 3
5	" x 3½

The above method may be applied to any log rule having a constant Mill Factor by simply changing the length of log. For example: M. F. 8, log 12 ft. and M. F. 6, log 16 ft.

FORM HEIGHT FACTORS

Sectional Area Breast High × F. H. F. = Cords of 128 Cubic Feet of Wood

SPECIES	SOLID CU. FT. PER CORD	DIAM. BREAST HIGH	TOTAL HEIGHT IN FEET										
			40	50	60	70	80	90	100	110	120	140	160
CHESTNUT EXTRACT WOOD	90	6	20	23	28								
		9	18	21	25	30							
		12	18	21	23	27	31						
		15	17	20	22	26	29	34	38				
		18		19	22	25	28	32	36				
		21		19	21	24	27	31	34				
		24		18	21	24	27	30	33				
		27		18	21	24	27	30	32	34			
		30			20	23	26	29	31	33			
		36				22	25	28	31	33			
		45					26	28	30	32			
SECOND GROWTH HARDWOOD	80 down to 1 inch	6	26	31	36								
		7	26	31	37								
		8	27	32	38								
		9		33	38								
		10		35	40								
		11		37	43								
		12		39	45								
SPRUCE (For Fir Multiply by .9)	95 down to 4 in.	6	18	22	28	34							
		9	20	26	30	35							
		12		26	30	34							
		15			30	33	38						
		18			29	32	36	42					
		21				32	36	40					
		24				32	35	38					
		27					34	37					
WHITE PINE	90	6	22	28									
		9	22	27	33								
		12		27	32	37	43	48	53				
		15			31	37	42	47	52	57	63		
		18				35	40	45	50	55	60		
		21					38	43	48	53	57		
		24						42	47	52	56	66	
		27						42	46	51	56	65	
		30							46	50	55	64	
		36							45	50	54	63	72
		45										62	70

SHORT-CUT FORM HEIGHT FACTORS

S. A. Breast High × F. H. F. = Cords of 128 cubic feet of wood

Species	Cords of 128 Cu. Ft. Containing	Total Height of Tree Feet	F. H. F.
Chesnut	90 solid cubic feet	75 ft. and under	$\frac{H}{5} + 10$
		Over 75 ft.	$\frac{H}{5} + 11$
	(For Long Cords of 160 cubic feet with 112 solid cubic feet)	75 ft. and under	$\frac{H}{6} + 8$
		Over 75 ft.	$\frac{H}{6} + 9$
Second growth Hardwood	80 solid down to 1 in.	30 ft. to 60 ft.	$\frac{H}{2} + D$
Spruce	95 solid down to 4 in.	65 ft. and under	$\frac{H}{2}$
		Over 65 ft.	$\frac{3\,H}{10} + 13$
Fir	95 solid down to 4 in.	65 ft. and under	$\frac{H}{2} - 2$
		Over 65 ft.	$\frac{2\,H}{5} + 2$
White Pine	90 solid cubic feet	80 ft. and under	$\frac{H}{2} + 2$
		90 ft. to 100 ft.	$\frac{H}{2}$
		110 ft. to 120 ft.	$\frac{H}{2} - 2$
		130 ft. to 170 ft.	$\frac{2\,H}{5} + 8$

CORDS OF BARK

Species	F. H. F. x S. A. breast high equals cords	Diameter Breast High	Diameter Factors Equals number of cords
Hemlock	.08	12–20	4 D — 10
Chestnut Oak		21–33	$\frac{3}{2}$ D — 24
	.14	12	
	.13	15	
	.12	18	
	.11	21	2 D — 16
	.10	24	
	.09	27	
		30	
		33	
	.08	36–48	3 D — 50

TABLES FOR USE IN GERMANY

FORM HEIGHT FACTORS

S. A. Breast High × F. H. F. = Cords of 128 cubic feet with 90 of solid wood over 2 3-4 in.

Height Feet	Oak	Beech	Spruce	Fir	Scotch Pine	U. S. White Pine
35		10	18	19	14	
40		16	21	22	20	22
45	20	21	25	26	24	25
50	25	25	28	29	26	27
55	28	28	32	32	28	30
60	32	31	34	35	31	33
65	35	35	37	38	33	35
70	38	38	40	41	35	37
75	41	41	42	43	38	39
80	44	44	45	46	40	42
85	48	47	48	48	42	43
90	51	50	50	51	45	45
95	54	53	53	53	47	47
100	58	56	54	54	50	50
105	60	58	57	57	52	
110	63		60	59	55	
115	68		63	60		
Short-Cut F. H. F. For all Heights	.6 H−4	.6 H−4	(Trees over 50 ft.) $\frac{H}{2}+5$	(Trees over 50 ft.) $\frac{H}{2}+5$	$\frac{H}{2}$	$\frac{H}{2}+2$

METRIC CONVERSION TABLE FOR FIELD WORK

Diameter in Centimetres × .4 = in.
Height in Metres ÷ .3 = feet
Kilometres × .621 = miles
Square Metres × $10\frac{3}{4}$ = sq. ft.
Hectares × $2\frac{1}{2}$ or 2.471 = acres
Cubic Metres × $35\frac{1}{3}$ = cubic feet

Cubic Metres ÷ $2\frac{1}{2}$ = Cords
Raumetres ÷ 3.6 = Cords
Cubic Metres per Hectare ÷ 6 = Cords per acre
Raumetres per Hectare ÷ 9 = Cords per acre
Cu. Metres per Hectare × 100 = Bd. ft. per acre
Cu. Metres per Hectare × 14 = Cu. ft. per acre
Price in marks per Cu. Metre = \$ per 1000
Price in marks per Raumetre × .9 = \$ per Cord

The German Foresters

Are growing Oak in rotations of 150 years at $100 to $200 per thousand board feet, the Corner Stone of Conservative Forestry being High Stumpage Price.

The foundation for Destructive Forestry is laid by low prices and low tariff, high taxes and high freight rates, "hot fires and cold logic," free trade and unlimited competition.