



LXV. Method of ascertaining the value of growing timber trees, at different and distant periods of time

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hooks takes one of the arms of the anchor, close to the shank, and holds it firmly. *ii* are two small lines made fast to the hooks, to direct them so as to get proper hold of the anchor.

Reference to the Engraving of Captain H. L. BALL's Improvement in the Formation of Anchors. See Plate X. Figs. 6, 7, and 8.

This anchor, in external appearance, differs very little from the common anchor; the improvement consists in forming and fixing of the shank of the anchor to the stock. The stock *aa*, figs. 6 and 7, is made of two pieces of oak bolted together, and well secured by hoops. In the common method, in order to prevent the anchor stock from slipping off the shank, a square projection *bb*, fig. 8, is forged upon the shank; this is improved by captain Ball, as shown in fig. 6, where this projection *dd* is extended on each side of the shank, far enough to receive two bolts through each of these extensions, which bolts hold firmly together the two pieces of timber which form the stock, and secure the stock fast to the shank. Two iron hoops, fig. 7, *ee*, are driven on the stock between the bolts, and *ffff* are other hoops, and *ggg* are tree-nails to strengthen the whole.

LXV. *Method of ascertaining the Value of Growing Timber Trees, at different and distant Periods of Time. By Mr. CHARLES WAISTELL, of High Holborn.*

[Concluded from p. 332.]

Observations on Tables I. and II.

THE preceding tables furnish us with the following useful information, viz.

1st. That all regular growing trees, measured as above, as often as their age is increased one-fourth, contain very nearly double their quantity of timber.

2d. That when a tree has doubled its age, its contents will be eight-fold.

3d. That when a tree has doubled its age, the annual growth will be increased four-fold.

4th.

4th. Consequently, that when a tree has doubled its age, the proportion that its annual increase bears to the contents of the whole tree is then diminished one-half.

This last observation explains how it comes to pass that a tree, when its age is doubled, the rate per cent. per annum that its increase then bears to the content of the whole tree, is diminished one-half.

It may not be unuseful to observe, that the rate per cent. of increase in the last columns, is the same as the rate per cent. that the increase of the tree that year will pay for the money it was worth the preceding year.

In the two preceding tables, we find that the rate of increase per cent. per annum is the same in both at the same ages, although the quantity of timber in the second table is six times as much as in the first table in trees of all ages: therefore, when the age of a tree is known, the rate per cent. per annum of its increase is known on inspecting these tables, whether the tree has grown fast or slow; provided the growth of the tree has been regular, and that it has continued its usual growth.

And having the age, girt, and height, of any tree given, we can readily calculate what quantity of timber it will contain at any future period whilst it continues its usual rate of growth.

A Table showing the Number of Trees to be cut out in thinning of Woods, and the Number left standing at every Period of 4 Years from 20 up to 64 Years.

In the 24th Volume of the Transactions of the Society of Arts, &c. page 75, Mr. Salmon, in a paper on the Management of Fir Woods, says, "the distance of trees from each other should be one-fifth of their height." At that distance, which is probably sufficient for fir trees, the following will be the number on an acre, and the number to be cut out at the ages and heights under mentioned, and the number of feet they will then contain in the bole, when measured to the top of the leading shoot. These trees are supposed to increase twelve inches in height, and one in circumference,

circumference, annually, and to have been at first planted four feet apart.

TABLE III.

Years old and feet high.	Girt.	Contents.			Distance.	Number of Trees on an Acre.	Contents of the whole.	Number to be cut out.	Contents.
	inch.	ft.	in.	pts.	feet.		feet.		feet.
20	2 $\frac{1}{4}$	0	10	5	4	2722	2362	839	727
24	3	1	6	0	4.8	1883	2824	494	741
28	3 $\frac{1}{2}$	2	4	7	5.6	1389	3308	326	776
32	4	3	6	8	6.4	1063	3779	223	792
36	4 $\frac{1}{4}$	5	0	9	7.2	840	4252	160	810
40	5	6	11	4	8	680	4722	118	819
44	5 $\frac{1}{2}$	9	2	11	8.8	562	5194	90	831
48	6	12	0	0	9.6	472	5664	70	840
52	6 $\frac{1}{4}$	15	3	0	10.4	402	6130	55	838
56	7	19	0	8	11.2	347	6611	45	857
60	7 $\frac{1}{2}$	23	5	2	12	302	7076	37	866
64	8	28	5	4	12.8	265	7537		

And if trees be periodically thinned out to the distance of one-fifth of their height, and that they increase fifteen inches in height, and one inch and a half in circumference, annually, the number of trees on an acre, and the number to be cut out at different periods, and the number of feet they will respectively contain at those periods, will be as under, viz.

TABLE IV.

Age.	Hght.	Girt.	Contents.			Distance	Number of Trees on an Acre.	Contents of the whole.	Number to be cut out.	Contents.
years.	feet.	inch.	ft.	in.	pts.	feet.		feet.		feet.
16	20	3	1	3	0	4	2722	3402	980	1225
20	25	3 $\frac{1}{2}$	2	5	3	5	1742	4246	532	1296
24	30	4 $\frac{1}{2}$	4	2	7	6	1210	5100	322	1357
28	35	5 $\frac{1}{4}$	6	8	4	7	888	5944	208	1392
32	40	6	10	0	0	8	680	6800	143	1430
36	45	6 $\frac{3}{4}$	14	2	10	9	537	7644	102	1452
40	50	7 $\frac{1}{2}$	19	6	4	10	435	8494	75	1464
44	55	8 $\frac{1}{4}$	25	11	10	11	360	9355	58	1507
48	60	9	33	9	0	12	302	10192	45	1518
52	65	9 $\frac{3}{4}$	42	10	10	13	257	11026	35	1501
56	70	10 $\frac{1}{2}$	53	7	0	14	222	11895	29	1553
60	75	11 $\frac{1}{4}$	65	10	11	15	193	12720	23	1515
64	80	12	80	0	0	16	170	13600		

It

It will be observed in all these tables, that when trees have doubled their age, there are only one-fourth of the number remaining on an acre, in consequence of their distance being doubled; but as each tree will then have increased its contents eight-fold, therefore the number of feet on an acre must be then doubled. Above, at 64 years of age, there is exactly double the number of feet that there is at 32 years of age.

And if trees be periodically thinned out to the distance of one-fifth of their height, and that they increase eighteen inches in height, and two inches in circumference, annually, the number of trees on an acre, and the number to be cut out at different periods, and the number of feet they will then respectively contain, will be as under, viz.

TABLE V.

Age.	Hght.	Girt.	Contents.	Distance.	Number of Trees on an Acre.	Contents of the whole.	Number to be cut out.	Contents.
years.	feet.	inch.	ft. in. pt.	feet.		feet		feet.
12	18	3	1 1 6	4'	2722	3062	839	943
16	24	4	2 8 0	4·8	1883	5021	673	1794
20	30	5	5 2 6	6'	1210	6302	370	1927
24	36	6	9 0 0	7·2	840	7560	223	2007
28	42	7	14 3 6	8·4	617	88·7	145	2072
32	48	8	21 4 0	9·6	472	10069	99	2112
36	54	9	30 4 6	10·8	373	11314	71	2153
40	60	10	41 8 0	12'	302	12583	52	2166
44	66	11	55 5 6	13·2	250	13864	40	2218
48	72	12	72 0 0	14·4	210	15120	32	2304
52	78	13	91 6 6	15·6	178	16294	24	2197
56	84	14	114 4 0	16·8	154	17607	20	2286
60	90	15	140 7 6	18'	134	18843	16	2250
64	96	16	170 8 0	19·2	118	20138		

But if the trees be first planted four feet apart, and be periodically thinned out to the distance of one-fourth of their height, and that they increase twelve inches in height, and one in circumference, annually, the number of trees on an acre, and the number to be cut out at the ages and heights under mentioned, and the number of feet they will respec-

tively contain in the bole, when measured to the top of the leading shoot, will be as under, viz.

TABLE VI.

Years old and feet high.	Girt.	Contents.			Distance.	Number of Trees on an Acre.	Contents of the whole.	Number to be cut out.	Contents.
		inch.	ft.	in. pt.					
16	2		0	5 4	4	2722	1209	980	435
20	2½		0	10 5	5	1742	1512	532	461
24	3		1	6 0	6	1210	1815	322	483
28	3½		2	4 7	7	888	2115	208	495
32	4		3	6 8	8	680	2417	143	508
36	4½		5	0 9	9	537	2718	102	516
40	5		6	11 4	10	435	3020	75	520
44	5½		9	2 11	11	360	3327	58	536
48	6		12	0 0	12	302	3624	45	540
52	6½		15	3 0	13	257	3919	35	533
56	7		19	0 8	14	222	4230	29	551
60	7½		23	5 2	15	193	4522	23	538
64	8		28	5 4	16	170	4835	20	568
68	8½		34	1 4	17	150	5116	16	545
72	9		40	6 0	18	134	5427	14	567
76	9½		47	7 6	19	120	5715	12	571
80	10		55	6 8	20	108	6000	10	555
84	10½		64	3 8	21	98	6301	8	554
88	11		73	11 4	22	90	6655	8	591
92	11½		84	5 11	23	82	6928	7	591
96	12		96	0 0	24	75	7200	6	576
100	12½		108	6 0	25	69	7486	5	542
104	13		122	0 8	26	64	7811	5	610
108	13½		136	8 3	27	59	8037	4	546
112	14		152	5 4	28	55	8384	4	609
116	14½		169	4 5	29	51	8659	3	508
120	15		187	6 0	30	48	9000	3	562
124	15½		206	10 7	31	45	9309	3	620
128	16		227	6 8	32	42	9557	2	455
132	16½		240	6 8	33	40	9982		

And if the trees be periodically thinned out to the distance of one-fourth of their height, and that they increase 13 inches in height, and one inch and a half in circumference annually, the number of trees on an acre, and the number to be cut out at the different periods under mentioned, and the number of feet they will respectively contain at those periods, will be as under, viz.

TABLE

TABLE VII.

Age.	Hght.	Girt.	Contents.			Distance.	Number of Trees on an Acre.	Contents of the whole.	Number to be cut out.	Contents.
years.	feet.	inch.	ft.	in.	pt.	feet.		feet.		feet.
12	15	2 $\frac{1}{4}$	0	6	3	4'	2722	1417	980	510
16	20	3	1	3	0	5'	1742	2177	627	783
20	25	3 $\frac{1}{2}$	2	5	3	6'25	1115	2717	341	831
24	30	4 $\frac{1}{2}$	4	2	7	7'5	774	3262	206	868
28	35	5 $\frac{1}{4}$	6	8	4	8'75	568	3802	133	890
32	40	6	10	0	0	10'	435	4350	91	910
36	45	6 $\frac{1}{2}$	14	2	10	11'25	344	4897	66	938
40	50	7 $\frac{1}{2}$	19	6	4	12'5	278	5428	48	937
44	55	8 $\frac{1}{4}$	25	11	10	13'75	230	5976	37	962
48	60	9	33	9	0	15'	193	6513	29	978
52	65	9 $\frac{3}{4}$	42	10	10	16'25	164	7036	22	943
56	70	10 $\frac{1}{2}$	53	7	0	17'5	142	7608	19	1018
60	75	11 $\frac{1}{4}$	65	10	11	18'75	123	8106	15	988
64	80	12	80	0	0	20'	108	8640		

And if the trees be planted at $4\frac{1}{2}$ feet apart, and be periodically thinned out to the distance of one-fourth of their height; and that they increase 18 inches in height and two inches in circumference annually, the number of trees on an acre, and the number to be cut out at the different periods under mentioned, and the number of feet they will then respectively contain, will be as under, viz.

TABLE VIII.

Age.	Hght.	Girt.	Contents.			Distance.	Number of Trees on an Acre.	Contents of the whole.	Number to be cut out.	Contents.
years.	feet.	inch.	ft.	in.	pts.	feet.		feet.		feet.
12	18	3	1	1	6	4'5	2151	2419	941	1058
16	24	4	2	8	0	6'	1210	3226	436	1162
20	30	5	5	2	6	7'5	774	4031	237	1234
24	36	6	9	0	0	9'	537	4833	142	1278
28	42	7	14	3	6	10'5	395	5645	93	1329
32	48	8	21	4	0	12'	302	6442	63	1344
36	54	9	30	4	0	13'5	239	7249	46	1395
40	60	10	41	8	0	15'	193	8041	33	1375
44	66	11	55	5	6	16'5	160	8873	26	1441
48	72	12	72	0	0	18'	134	9648	20	1441
52	78	13	91	6	6	19'5	114	10435	16	1464
56	84	14	114	4	0	21'	98	11204	12	1372
60	90	15	140	7	6	22'5	86	12093	11	1546
64	96	16	170	8	0	24'	75	12800		

It is difficult in thinning plantations to leave the trees at nearly equal distances. The distances stated in all these tables must be considered the average distances. If, for instance, there be 302 trees on an acre, their average distance will be 12 feet, although few of them may stand at exactly that distance.

If the trees be first planted four feet apart, and be periodically thinned out to the distance of one-fourth of their height until they are 28 feet high, and to one-third of their height afterwards, and that they increase 12 inches in height and one in circumference annually, the number of trees on an acre, and the number to be cut out at the ages and heights under mentioned, and the number of feet they will then respectively contain in the bole, when measured to the top of the leading shoot, will be as under, viz.

TABLE IX.

Years old and feet high	Girt.	Contents.	Distance.	Number of Trees on an Acre.	Contents of the whole.	Number to be cut out.	Contents.
	inch.	feet in. pts.	feet		feet.		feet.
16	2	0 5 4	4	2722	1209	980	435
20	2½	0 10 5	5	1742	1512	532	461
24	3	1 6 0	6	1210	1815	322	483
28	3½	2 4 7	7	888	2115	453	1078
30	3¾	2 11 1	10	435	1271	133	388
36	4½	5 0 9	12	302	1528	80	404
42	5½	8 0 5	14	222	1783	52	417
48	6	12 0 0	16	170	2040	36	432
54	6¾	17 1 0	18	134	2289	26	444
60	7½	23 5 2	20	108	2530	18	421
66	8½	31 2 4	22	90	2807		

Observations on Table IX.

On examining several oak woods, it appeared to me, that the distance of one-third of their height was not too much where the trees were from 30 to 40 feet high and upwards. I have therefore calculated a table according to the distance of one-fourth of their height, till they are 28 feet high, and according to the distance of one-third of their height afterwards.

The

The timber to be thinned out before the age of 28 years, will be the same as in Table VI., but at 28 years of age there are 583 feet more to be cut out according to this Table than at the same age in Table VI.; there will, however, be less to be cut out between the ages of 28 and 60 years of age. But if the trees in this Table, in consequence of having more room, were to increase $1\frac{1}{4}$ inch in circumference annually, instead of one inch after they are 28 years of age, the produce of an acre at 60 years of age would equal the produce stated in Table VI. at the same age; taking into consideration that the value of the 583 feet excess cut out at 28 years of age would then be more than quadrupled, if the money were placed out at five per cent. compound interest. A considerable additional increase in circumference may certainly be expected, in consequence of the trees having almost double the room in which to extend their branches, and for the admission of those powerful agents, sunshine and air.

Observations on the Tables respecting the Thinning of Woods, and their Produce.

Mr. Salmon is the only person I know of, who has given a general rule for thinning plantations. But as I conceive his distance of one-fifth of their height would leave oaks too close, especially after they had acquired a sufficient length of stem, I have calculated both on his plan, which is proper for fir trees, and also at greater distances.

The preceding Tables VI. VII. and VIII. are calculated on a supposition that the trees are never suffered to stand nearer, on an average, than one-fourth of their height; and although the quantities of timber thinned out and left standing on the ground at that distance, at the end of 60 years, be only two-thirds of the quantity according to Mr. Salmon's distance, yet I suppose it will be generally thought an ample produce and sufficiently encouraging.

According to Table VI. which is calculated for oaks, the first thinning is at sixteen years old, and the second at twenty, but it is the advice of an eminent planter, (Mr.

Pontey,) to begin thinning at about thirteen years old, according to the state of the trees, and to cut out about 150 poles per acre annually, for the next seven years. Without putting any value upon the thinnings before 20 years old, we find that at the 20th and 24th years the thinnings measure 945 feet, the value of which, at a low estimate, will be sufficient to repay the rent and taxes of ground of a moderate quality, the expense of plants, planting, and after-management, calculated at five per cent. compound interest.

When 28 years old, and at the end of every fourth year following, up to 120, the trees to be cut out of an acre will measure from 495 to 550 feet; but say 500, at 4s. a foot, on an average, including the value of the bark; this gives 100*l.* which sum divided by 4, leaves 25*l.* for the produce per acre per annum. This deserves the consideration of those who are inclined to convert young woods into coppices, without leaving a reasonable number of standards.

It may however be said, that as the trees cut out in thinning plantations are the bad thrivers and underlings, their contents will be less than the average; but, if we take their value at one-half the above estimate, that is, after the rate of 12*l.* 10*s.* per acre per annum at 28 years of age and upwards, even this produce must be thought ample, together with the value of the trees left standing.

Table VI. was constructed chiefly with a view to oaks, their annual increase in circumference varying from $\frac{3}{4}$ of an inch to $1\frac{1}{4}$ inch, the medium of which is one inch,

Tables VII. and VIII. were calculated for ash, elm, sycamore, firs, poplars, and other woods of swift growth, their increase in circumference being generally from $1\frac{1}{2}$ to 2 inches annually. If ash trees be found to increase after the rates of Table VII. or VIII. they must be exceedingly profitable, at the high prices now given for that timber. Many other observations might be made on Tables VII. and VIII., but these will readily occur to persons interested in quick-growing trees.

An acre of trees increasing after the rate of Table VI. produces in 64 years little more than half the number of feet
that

that another acre produces which increases after the rate of Table VII., and little more than one-third of another, increasing after the rate of Table VIII. in the same time.

In planting with a view to profit, the first object is a long, straight, and clear stem. This is most certainly and speedily obtained by thick planting at first, and not thinning too soon. A kind of competition among the trees is thereby occasioned, each struggling, as it were, to outgrow its neighbour, in search of light, heat, air, and moisture.

This competition must, however, be judiciously moderated by timely thinning; always keeping the trees sufficiently strong in the stem. If they be suffered to stand some years too near each other, their stems will become weak, and bend under their small tops when thinned. Where this has taken place in only a small degree, they will make but little progress for some years afterwards.

By the time the trees have advanced to 24 or 30 feet high this competition should cease, if they are intended to be cut down at or before 60 years of age, and they should then be encouraged to extend their tops more in width than in height, strong side branches being apparently quite as conducive as the leading shoot, to the vigorous growth of the bole below them. After this period, the best rule for thinning will probably be, to leave a clear space around the top of each tree, in which the branches may extend themselves without obstruction. A tree whose top is 20 feet diameter, receives four times the benefit from air, rain, and dew, as another does whose top is only ten feet diameter.

The trees in the interior of young woods are smaller in their boles than the exterior trees. And in a fine oak wood, of about 40 acres, divided into squares by several avenues or ridings crossing each other at right angles, I observed the rows of trees next the avenues much thicker in their boles than the trees in the interior of the squares; owing, no doubt, to their having more and larger branches in consequence of their having more room, although it is only on one side.

Being too parsimonious of ground seems to me a great and very general error. If the same number of trees of 32

feet high and upwards, in Table VI. were allowed the space of two acres instead of one, and, in consequence of their standing thinner, were to increase annually only the fiftieth part of an inch more in girth than they would do if they stood on one acre, this small additional increase in girth would pay an ample rent for the additional acre.

In the year 1791 a paper of Observations on the Propagation and Management of Oak Trees in general, but more particularly applying to his majesty's New Forest in Hampshire, was published by T. Nichols, Purveyor of the Navy for Portsmouth Dock-yard.

In this paper it is said, that "there are to be seen in many parts of the forest from 40 to 50 fine oaks standing on an acre, that will measure one with another two loads a tree."

"Several woods in the forest are almost ruined for want of thinning, and its being done at proper times; particularly the inclosures that were made in the year 1700:—these were originally well planted, and great numbers of trees brought up in them, which now remain so close together that they are nearly stagnated, particularly in Salisbury, Trench, Brimley Coppice, and Woodfidley; and although it is 90 years since they were planted, the trees will not measure, one with another, above six or seven feet a tree; whereas, if the business of thinning had been done as it ought, the remaining trees (after drawing much useful timber) would by this time have been of a size nearly fit for naval uses, as in some of the woods that were planted at the same time, the trees which have had room to expand, and a free air admitted to them, will measure from 70 to 80 feet."

Observations on the Growth of Timber.

The rings observable in the transverse section of a tree at its butt-end, are the same in number as the years of its age; an additional ring being produced annually, in consequence of the annual rising of the sap. The rings are nearly concentric in trees that have grown in the interior of close shady woods, but eccentric in others, being of different breadths on the northern and southern sides of such as have grown single,

single, or in any other situation where their boles have been much exposed to the rays of the sun. This difference is occasioned by the different degrees of heat to which the opposite sides of the boles of trees are exposed. And, indeed, we find these rings are always broadest on that side of the bole or stem most warmed by the sun. Hence we see the utility of exposing their boles as much as possible to its rays*. It is often seen in the stumps of trees that have stood single, that they have grown nearly twice as fast on the southern side as on the northern, their pith being so much nearer to the northern side.

It is, however, to be remarked, that the wood from that side of a tree which has grown the slowest, is heavier than from the opposite side which has grown the fastest, and it is probably stronger in the same degree.

It may be worth the consideration of those who have southern hangs or declivities to plant, whether to plant, or rather leave the trees in thinning, in double rows in lines running east and west, at about fourteen or sixteen feet distance, and the double rows at about thirty-six feet distance, less or more, according as the declivity is more or less, in order that their boles may receive the greatest possible benefit from the direct rays of the sun.

No doubt many gentlemen are in possession of facts that would in some degree ascertain how much faster the boles of trees swell that stand exposed to receive the full benefit of the warmth of the sun, than those that are either partially or constantly in the shade. To make these facts known would materially benefit planters; for I am fully persuaded that there are but few persons apprised of the magnitude of the power of the sun's rays upon the boles of trees in causing them to swell.

Of the most profitable Length of Boles of Trees.

We rarely see timber trees pruned, and still more rarely

* On a hot day in the middle of May I have observed the mercury in the thermometer to rise and fall from twelve to sixteen degrees, on hanging it alternately in the sunny and shady sides of the same tree, between the hours of two and five o'clock, at which time of the day the heat is generally the greatest.

do we see the pruning performed in a judicious manner. This business should commence early, never suffering the branches on the intended stem or bole to grow to a large size, in order that, when cut off, the wounds may be small and soon healed. Those who want directions for performing the operation, may think it well to consult Mr. Pontey's Forest Pruner. There are, however, divers opinions as to the most profitable height to which trees ought to be pruned, and the instruments most proper for pruning; some persons objecting to the use of the saw, unless afterwards smoothed by the knife; and not a few objecting to pruning in any way; the consequence of which is, that we often find trees that stand single, particularly oaks, with boles not more than six or eight feet high, but with wide spreading bushy tops, fit only for the fire. The shade and drip of one such tree is sometimes found to do more injury than four well-trained trees, and perhaps it is not of half the value of one of them. On the contrary, trees in close plantations are often suffered to stand so much too thick as to destroy each others branches, excepting only a few small ones near their tops; and not unfrequently we see tall elms trimmed up to within a few feet of their summits—it is certain that such trees must swell very slowly in their boles; for we find in woods where the trees are all of the same age, that those with the largest tops have generally the thickest boles.

There is no doubt a medium length of bole for different kinds of trees on different soils, that will be found productive of more timber, or timber of more value, than boles that are much longer or much shorter. And although we may not be able previously to decide with certainty what that exact length of bole is, in any kind of trees, on any soil, which will eventually prove most profitable, yet it is deserving of investigation, if we can thereby approach with certainty to within a few feet of the exact point. It is certainly a matter of too much importance to be left, as it generally is, to each individual woodman to decide upon, according to his own vague opinion. I shall, therefore, take the liberty of stating by what steps I have endeavoured to approximate towards the most profitable lengths of boles of trees

trees of different rates of growth, that are not intended to stand beyond the age of sixty years.

In the preceding tables the trees are supposed to be measured to the top of the leading shoot, but in the following tables only to the height of their boles of 24, 32, and 40 feet.

Tables showing the Increase of Boles of Trees of different Lengths.

If a tree has increased twelve inches in height and one in circumference annually, until it is twenty-four years old, it will then be twenty-four feet high, and three inches girt at twelve feet high; and supposing that in process of time this tree be pruned up so as to leave the bole twenty-four feet high clear of branches, and that it continue increasing one inch in circumference annually, the rate per cent. per annum of its increase will be as under, exclusive of the increase of timber in its top and lateral branches.

TABLE X.

Years old.	Girt	Contents.	Years old.	Girt.	Contents.	One Year's Increase.	Increase per Cent. per Ann.
	in.	ft. in. pt.		in.	ft. in. pt.	ft. in. p	
24	3	1 6 0	25	3 $\frac{1}{4}$	1 9 1	0 3 1	17.1
28	4	2 8 0	29	4 $\frac{1}{4}$	3 0 1	0 4 1	12.7
32	5	4 2 0	33	5 $\frac{1}{4}$	4 7 1	0 5 1	10.1
36	6	6 0 0	37	6 $\frac{1}{4}$	6 6 1	0 6 1	8.4
40	7	8 2 0	41	7 $\frac{1}{4}$	8 9 1	0 7 1	7.2
44	8	10 8 0	45	8 $\frac{1}{4}$	11 4 1	0 8 1	6.3
48	9	13 6 0	49	9 $\frac{1}{4}$	14 3 1	0 9 1	5.6
52	10	16 8 0	53	10 $\frac{1}{4}$	17 6 1	0 10 1	5.04
56	11	20 2 0	57	11 $\frac{1}{4}$	21 1 1	0 11 1	4.5
60	12	24 0 0	61	12 $\frac{1}{4}$	25 0 1	1 0 1	4.1
64	13	28 2 0	65	13 $\frac{1}{4}$	29 3 1	1 1 1	3.8
68	14	32 8 0	69	14 $\frac{1}{4}$	33 10 1	1 2 1	3.5
72	15	37 6 0	73	15 $\frac{1}{4}$	38 9 1	1 3 1	3.3
76	16	42 8 0	77	16 $\frac{1}{4}$	44 0 1	1 4 1	3.1
80	17	48 2 0	81	17 $\frac{1}{4}$	49 7 1	1 5 1	2.9
84	18	54 0 0	85	18 $\frac{1}{4}$	55 6 1	1 6 1	2.7
88	19	60 2 0	89	19 $\frac{1}{4}$	61 9 1	1 7 1	2.6
92	20	66 8 0	93	20 $\frac{1}{4}$	68 4 1	1 8 1	2.5
96	21	73 6 0	97	21 $\frac{1}{4}$	75 3 1	1 9 1	2.3
100	22	80 8 0	101	22 $\frac{1}{4}$	82 6 1	1 10 1	2.2
120	27	121 6 0	121	27 $\frac{1}{4}$	123 9 1	2 3 1	1.8
140	32	170 8 0	141	32 $\frac{1}{4}$	173 4 1	2 8 1	1.5
160	37	228 2 0	161	37 $\frac{1}{4}$	231 3 1	3 1 1	1.3

But

But if a tree increase 12 inches in height and one inch in circumference annually, until it be 32 feet high, and in process of time the bole be pruned up to that height, the rate per cent. per annum of the increase of this bole will be as under, exclusive of the increase in its top and lateral branches.

TABLE XI.

Years old.	Girt.	Contents.			Years old.	Girt.	Contents.			One Year's Increase.	Increase per Cent. per Ann.
	inch.	ft.	in.	pt.		inch.	ft.	in.	pt.	ft. in. pt.	
32	4	3	6	8	33	4 $\frac{1}{4}$	4	0	2	0 5 6	12.9
36	5	5	6	8	37	5 $\frac{1}{4}$	6	1	6	0 6 10	10.25
40	6	8	0	0	41	6 $\frac{1}{4}$	8	8	2	0 8 2	8.5
44	7	10	10	8	45	7 $\frac{1}{4}$	11	8	2	0 9 6	7.3
48	8	14	2	8	49	8 $\frac{1}{4}$	15	1	6	0 10 10	6.3
52	9	18	0	0	53	9 $\frac{1}{4}$	19	0	2	1 0 2	5.6
56	10	22	2	8	57	10 $\frac{1}{4}$	23	4	2	1 1 6	5.06
60	11	26	10	8	61	11 $\frac{1}{4}$	28	1	6	1 2 10	4.59
64	12	32	0	0	65	12 $\frac{1}{4}$	33	4	2	1 4 2	4.2
68	13	37	6	8	69	13 $\frac{1}{4}$	39	0	2	1 5 6	3.88
72	14	43	6	8	73	14 $\frac{1}{4}$	45	1	6	1 6 10	3.6
76	15	50	0	0	77	15 $\frac{1}{4}$	51	8	2	1 8 2	3.36
80	16	56	10	8	81	16 $\frac{1}{4}$	58	8	2	1 9 6	3.1
100	21	98	0	0	101	21 $\frac{1}{4}$	100	4	2	2 4 2	2.39
120	26	150	2	8	121	26 $\frac{1}{4}$	153	1	5	2 10 9	1.92

But if a tree increase 12 inches in height and one inch in circumference annually, until it be 40 feet high, and in process of time the bole be pruned up to that height, the rate per cent. per annum of the increase of this bole will be as under, exclusive of the increase in its top and lateral branches.

TABLE XII.

Years old.	Girt.	Contents.			Years old.	Girt.	Contents.			One Year's Increase.	Increase per Cent. per Ann.
	inch.	ft.	in.	pt.		inch.	ft.	in.	pt.	ft. in. pt.	
40	5	6	11	4	41	5 $\frac{1}{4}$	7	7	10	0 8 6	10.2
44	6	10	0	0	45	6 $\frac{1}{4}$	10	10	2	0 10 2	8.47
48	7	13	7	4	49	7 $\frac{1}{4}$	14	7	2	0 11 10	7.2
52	8	17	9	4	53	8 $\frac{1}{4}$	18	10	10	1 1 6	6.3
56	9	22	6	0	57	9 $\frac{1}{4}$	23	9	2	1 3 2	5.6
60	10	27	9	4	61	10 $\frac{1}{4}$	29	2	2	1 4 10	5.05
64	11	33	7	4	65	11 $\frac{1}{4}$	35	1	10	1 6 6	4.58
68	12	40	0	0	69	12 $\frac{1}{4}$	41	8	2	1 8 2	4.2
72	13	46	11	4	73	13 $\frac{1}{4}$	48	9	2	1 9 10	3.87
76	14	54	5	4	77	14 $\frac{1}{4}$	56	4	10	1 11 6	3.59
80	15	62	6	0	81	15 $\frac{1}{4}$	64	7	2	2 1 2	3.35
100	20	111	1	4	101	20 $\frac{1}{4}$	113	10	10	2 9 6	2.51
120	25	173	7	4	121	25 $\frac{1}{4}$	177	1	2	3 5 10	2.00

Observations

Observations respecting Trees of different Lengths in the Bole.

Trees that increase annually 12 inches in height and one in circumference, and have boles of different lengths, these boles, if of the under-mentioned lengths, increase after the rate of five per cent. per annum at the ages and heights under mentioned, and they measure as under, viz.

			Years old.	In.	Ft.	Contents.		
Trees with	12 feet boles at	46	their girt	10 at	6 high,	Ft.	in.	p.
Do.	16 do.	48	do.	10 at	8 do.	11	1	4
Do.	24 do.	52	do.	10 at	12 do.	16	8	0
Do.	32 do.	56	do.	10 at	16 do.	22	2	8
Do.	40 do.	60	do.	10 at	20 do.	27	9	4
Do.	48 do.	64	do.	10 at	24 do.	32	4	0

Whatever the lengths of the boles of trees increasing as above may be, the increase is 5 per cent. per annum one year after their girt in the middle is ten inches, but not longer.

But supposing that these trees have grown to 60 years of age, and increased as above mentioned, their girt and contents at that age would be as under, viz.

					Contents.		
Trees with	16 feet boles,	13	inches girt at	8 feet high,	18	9	4
Do.	20 do.	12½	do.	10 do.	21	8	5
Do.	24 do.	12	do.	12 do.	24	0	4
Do.	32 do.	11	do.	16 do.	26	10	8
Do.	40 do.	10	do.	20 do.	27	9	4

This table shows that the advantage to be gained by pruning trees higher than 32 feet, is not an object worthy of consideration, if the trees are to be cut down at the age of 60 years.

And if it should be found that the higher a tree is pruned the slower it swells in the bole, perhaps a 24 feet bole may measure as much at 60 years old as a 32 feet bole. If it increases half an inch in girt in the last 36 years more than the 32 feet bole increases in the same time, it will very nearly equal it in measure.

A 32 feet bole with a top from 20 to 30 feet high, with many large lateral branches, is certainly a much finer object than a forty feet bole with a top only twenty feet high, with few and small lateral branches: and at sixty years old, the former will have had to increase in the last twenty-eight years, only one quarter of an inch in girt, more than the latter,

latter, to exceed it in measure, to say nothing of the excess of timber in the larger top and branches. It must, however, be remarked, that at eighty years of age, the forty feet bole will exceed the thirty-two feet bole nearly six feet; and at one hundred years, thirteen feet, provided it swell equally fast in thickness. But unless the trees be oak, fit for the use of the navy, for which an increased price can be had, I imagine few gentlemen would now choose to let their trees stand to eighty years of age, when the increase of their boles will not be four per cent.; still fewer would let them stand to one hundred, when the increase will not be three per cent. per annum.

Again, let it be supposed that trees sixty years of age have increased annually, during their growth, fifteen inches in height, and one inch and a half in circumference, the girt and contents of their boles, if of the under-mentioned lengths, will be as under, viz.

						Contents.	
						Ft.	in. pt.
Trees with 20 feet boles, will be $19\frac{1}{2}$ inches girt at 10 feet high,						52	9 9
Do.	25	do.	$18\frac{3}{4}$	do.	$12\frac{1}{2}$	61	0 5
Do.	30	do.	18	do.	15	67	6 0
Do.	40	do.	$16\frac{1}{2}$	do.	20	75	7 6
Do.	50	do.	15	do.	25	78	1 6

Taking it for granted that the shorter boles will increase faster in thickness than the longer ones, it is reasonable to expect that the forty feet bole will contain more timber than the fifty feet bole when they are both sixty years old; and if they are both sold at the same rate per foot, the forty feet bole must consequently be more valuable. If, however, a higher price can be had for longer boles, this may compensate not only for their deficiency in measure at sixty years of age, but also for their standing beyond the period when they cease paying the common rate of interest for the money they are worth, which I suppose is frequently the case as to tall elm trees, fit for keel pieces, and perhaps beech for ship planking. It is hence evident, that where the soil is such as will enable trees to grow to a great height, it will be necessary, before we decide how high to prune them, to consider to what purposes the timber can be most advantageously appropriated.

Whatever

Whatever the lengths of the boles of trees increasing as above may be, their increase is five per cent. per annum, one year after their girt in the middle is 15 inches, but not longer.

Again, let it be supposed that trees sixty years of age have increased annually, during their growth, eighteen inches in height, and two inches in circumference, the girt and contents of their boles, if of the under-mentioned lengths, will be as under, viz.

						Contents.	
						Ft.	in. pt.
Trees with 24 feet boles, will be .26 inches girt at 12 feet high,						112	8 0
Do. 30 do. 25 do. 15 do.						130	2 6
Do. 36 do. 24 do. 18 do.						144	0 0
Do. 48 do. 22 do. 24 do.						161	4 0
Do. 60 do. 20 do. 30 do.						166	8 0

Here again we may suppose that the forty-eight feet bole, by swelling faster than the sixty feet bole, may exceed it in measure at sixty years of age, and this it would do, were the girt increased only half an inch. And if the thirty-six feet bole was increased two inches in girt, it would exceed both the forty-eight and sixty feet boles. But trees of such swift growth are frequently cut down before they are sixty years old. At forty years of age the thirty-six feet bole, if it swell no faster than the forty-eight feet bole, will contain more timber if measured according to the present erroneous method. (The greater disproportion there is between the two ends of a piece of timber, and the more disadvantageously it measures, when the girt is taken in the middle.) I suppose that in timber of this swift growth, the longer boles are frequently not worth more per foot than the shorter boles; therefore, in this case, that length of bole should be fixed on which is likely to measure most at the period when the trees are intended to be felled.

Whatever the lengths of the boles of trees increasing as above may be, their increase is five per cent. per annum, one year after their girt in the middle is 20 inches, but not longer.

It appears from the last observations and calculations, that the annual increase in the boles of trees by their growth, ceases to be equal to five per cent. per annum some time between

between forty-six and sixty years of age, according as the boles are shorter or longer.

But it being generally allowed that oak trees, of a size fit for the navy, require to grow from eighty to one hundred and fifty years, according to the quality of the soil, and it is so stated in the eleventh report of the commissioners appointed to inquire into the state and condition of the woods, forests, and land revenues of the crown; I have therefore been calculating tables, showing what the proportionably advanced prices should be, at different periods, up to one hundred and fifty years, to pay the proprietors for letting their trees stand to those periods. These prices, especially at the later periods, very greatly exceed any that have ever been given. It certainly has been much the interest of the growers of oak timber to fell it at about sixty years of age, even if they replant the same ground. To let it stand to one hundred and twenty years of age, and sell it at the present prices, their loss would exceed double the whole value of the timber at sixty years of age. Nothing short of a sufficient price will long command a sufficient supply. Owing to too low prices, the quantity of large timber on private estates has long been rapidly decreasing; and it will be too late to commence offering reasonable prices for it when it is all gone, and no oaks left of greater growth than sixty years. To have to wait their growing the second sixty years, may bring upon us evils exceeding all calculation.

Valuations made in October, 1807, of several Plantations in Staffordshire.

The valuations were made of the trees growing within the space of a chain square, being the tenth part of an acre, of the medium growth of each plantation.

In the plantation by the mill wall there are now growing within twenty-two yards square, as under, viz.

	£.	s.	d.	£.	s.	d.
70 oak trees, containing 175 feet, at 2s. 3d.	19	13	9			
1200 of oak bark, at 12s.	7	4	0			
	26	17	9	or, per acre,	268	17 6
						The

The above is part of about four acres planted in 1775, on a strong loamy soil, worth about 20s. an acre. One pound per annum forborne 32 years, and improved at five per cent. compound interest, would amount to 75*l.* 6s. But the value of the timber is more than three times this amount.

The ground was prepared for planting by ploughing.

On the east side of Cottage Wood there are now growing, within twenty-two yards square, as under, viz.

	£.	s.	d.	£.	s.	d.
50 ashes, containing 300 feet,						
at 1 <i>s.</i> 6 <i>d.</i> - - -	22	10	0			
13 oaks do. 7 do. 2 <i>s.</i>	0	14	0			
Bark - - -	0	7	0			
	<hr/>					
	23	11	0	or, per acre,	235	10

The above is part of about two acres planted in 1776, partly on heaps of earth in clay pits, and partly on strong soil upon a deep bed of sand, value about 15s. an acre. Fifteen shillings per annum, forborne 31 years, and improved at five per cent. compound interest, would amount to - - - - - 53*l.* 0*s.* 0*d.* But the value of the timber is more than four times this amount.

In the clay pits only holes were dug for the plants, but the other part wholly trenched, or double dug with the spade.

In Pickmore Pool plantation there are now growing within twenty-two yards square, as under, viz.

97 Scotch firs, containing 636 feet*, at 1*s.*—31*l.* 16*s.* 0*d.* or, per acre, 318*l.* 0*s.* 0*d.*

The last plantation is part of about six acres planted in the springs of 1778 and-9. Much of the soil is a tough peat on gravel or hungry white sand, worth, say 5*s.* per acre.

This ground lay between two tenants who had never cultivated it. They had then nineteen years unexpired of their

* This produce is after the rate of 6360 feet an acre, which is about the rate of Table IV.

lease of thirty-one years of this and the adjoining lands, and willingly gave it up to be planted, on condition of having the fences made and kept in good repair.

Five shillings a year, forborne 29 years, and improved at five per cent. compound interest, would amount to 15*l.* 11*s.* 0*d.* But the value of the timber is more than twenty times this amount.

The trees were about two feet high, and planted at two yards distance, in holes dug with the spade, 1210 on an acre. Labour of making the holes and planting the trees cost 1*l.* 6*s.* 10½*d.* per acre.

About 2700 were planted on an acre in the other plantations, where the ground was wholly broken up.

In the remarks on these three plantations, no notice is taken of the thinnings. I am informed by gentlemen who have kept accounts of thinnings, that these have repaid the rent of the land and every expense, with compound interest, some time before the woods were thirty years old; and the preceding calculations show that it may be so. And if so, the present value of these plantations is all clear gain.

The valuer of these plantations has bought a good deal of wood out of them; and the prices he has valued at per foot, may possibly be a fair value there for such small timber.

The growth of the firs in the last-mentioned plantation, is probably as great in that poor ground as it would have been had they been planted on ground of three or four times its value; this must be a powerful inducement to gentlemen to plant all such poor ground in the first instance.

And a few of oaks, ashes, and firs, may be raised on almost every farm in screens, that may, by their shelter, increase the value of the farm to the occupier, by increasing the produce, particularly that of grass grounds. In this case the interest of landlord and tenant may be reciprocal; but it is the reverse where trees are planted in hedge-rows.

And even the sides and tops of high mountains may be made abundantly more productive of grass, if certain portions of them were surrounded by plantations. These plantations, by breaking the force of cold winds, diminish their chilling effect on the fields the plantations surround, and
render

render the climate on mountains much more mild and genial.

This last kind of improvement will generally be found very greatly to exceed the expectation of the improver, provided it be judiciously planned and executed.

May I take the liberty to suggest, that information of very great value might be obtained by the Society from the gentlemen to whom medals and premiums have been given for planting trees, if they would favour the Society with their subsequent observations respecting those plantations.

It would, for instance, be desirable to have the nature of the soil and under strata described,—the sorts of trees best suited thereto,—the distance at which the trees were first planted,—at what periods they were thinned, and how many cut out at each thinning, and their measure and value,—the present height, distance, measure, and value, of the trees now growing on an acre,—what distances are found most advantageous, and also the best height to be pruned.

The fund of information that such communications might afford, would prove of very great value indeed to future planters, as well as to many proprietors of plantations of different ages now growing.

If the Society should think it advisable to solicit this information, no doubt the ample and valuable materials they would thereby obtain, would enable some abler pen to do justice to the curious and important subjects of the preceding pages. In the mean time it is hoped, that this attempt to reduce our knowledge of the growth of timber to something like system, however imperfect it may be, will be received with indulgence. Assuredly, it had not so soon seen the light, had not the present situation of our country imperiously demanded of every individual his utmost exertion to render us as independent as possible of supplies of every kind from the continent of Europe, from which we are now almost totally excluded.

C. WAISTELL.

High Holborn, March 15, 1808.
To CHARLES TAYLOR, M.D. Sec.