A REPORT

ON

SOME OF THE FOREST PLANTATIONS OF MASSACHUSETTS.

BY

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1. INTRODUCTION.

INTRODUCTION.

The subject of forest plantations is one which is becoming increasingly important as time goes on. The fast disappearing forests of the United States and Canada make it necessary that some attempt be made to replenish the timber supply of both countries. Both state and private companies are cognizant of this fact, and both have made or less sporadic attempts to supplement the depleted areas by planting. Particularly is this the case in the older states of the Union, notably Massachusetts, and one may find scattered within its boundaries forest plantations ranging from the age of one year to sixty. Consequently, because of this, the Bay State is probably the best in which to observe the results of forest planting after a long period of years.

The purpose of this study has been to bring together certain facts which may be deduced from the study of a number of plantations of different species, grown on different sites.

The work was carried on chiefly with the Harvard Forest as a centre and embraced, besides the plantations at the Forest, all those which are within reasonable access therefrom.

The writer is indebted to Professor R. T. Fisher of the Harvard Forest School for assistance in securing the following data, and also to the State Department of Forestry for Massachusetts as well as private owners of plantations.

2. MOTES ON PLANTATIONS.

<u>Notes on the Plantations Visited.</u>

Harvard Forest Plantations.

The plantations at the Harvard Forest School have not the advantage of age which many other plantations in the state possess. The oldest at the time of writing would not exceed twelve years. Neither in size are the individual plantations as large as one might wish. The chief value, however, of these plantations is the admirable system of records which has been kept of each. After all, the investigator . ten. twenty or fifty years hence can draw few accurate conclusions if no records have been kept. The necessity of this cannot be stressed too strongly as the value of a plantation as an experiment is depreciated a great deal by such a lack, and the period of time which elapses between planting and harvesting is such that records must be put in a permanent form. In the case of the Harvard Forest School plantations, the record begins with the origin of the seed, mentions the nursery, describes fully the conditions of the site at the time of planting, gives the planting method used and notes on local factors.

Frivate plantations.

A great deal of private planting has been done in Massachusetts, and much credit and encouragement is due those who have been pioneers in this work. This has been carried on chiefly by those who are interested in replenishing land which otherwise would become eroded beyond recovery as well as utilizing better sites.

Also, the woodworking industries of the state, which are very numerous, have done considerable planting from an economic point of view, because they realize that if the supply of timber is to be maintained, some one must supplement the native stands by planting.

Wachusett Plantations.

The plantations at Clinton, forming a protection for the margins of the Wachusett Reservoir, are perhaps the most creditable piece of reforesting on the continent. The purpose here, primarily, has been to control the water runoff, of the adjoining slopes and the water courses entering the reservoir.

The lake which forms this magnificent reservoir, is about four miles long by two miles wide. It is situated in a natural basin formed by surrounding low hills. The area now occupied by the water has been appropriated largely from what, at one time, was productive farm land. Consequently, with a better quality of soil than that which plantations usually occupy, and with such excellent drainage which the sloping shores provide, the site is an ideal one for tree growth. Due to these factors, and partly also to the close proximity of a large body of water, the trees have made phenomenal growth.

The first planting at Wachusett was done in 1902 on lots 106 B; 107 F and 126 A, section G. This would make the oldest plantations, at the time the study was made (spring of 1920) eighteen years of age. Previous to two years ago, complete records of the work were to be had, but owing to the bursting of a large water conduit, which flooded and cleaned out part of the office building, these have since been destroyed.

State Plantations.

A number of State plantations were included in the report, but these were mostly young plantations, and no attempt was made to keep them separate from the privately owned plantations of the same age.

Older Plantations.

In 1915, the State Department of Forestry published a bulletin entitled "The Older Forest Plantations of Massachusetts, Conifers." It is not intended to trespass on the purpose of this publication, but simply to mention it here, because plantations which it includes must needs form an important part of such a study as this. The purpose was to show by illustration and measurement, what might be expected in a few years, if the land owners of the state would plant trees. The introduction of the bulletin gives some interesting glimpses into the origin of some of these odder plantations.

"The period between 1820 and 1880 was one of enthusiastic planting of pine in New England. The lumberman foresaw the time when natural white pine as a marketable commodity would be gone, and the rise in prices would make planted timber of economic importance. Large plantations were made by private owners, and a few by corporations. Seed lings were usually dug up from the fields lying around old seed pines, and planted either at random or in rows, and spaced at distances varying from 4 to 15 feet. Seed plots were attempted by some, and others even tried out broadcast sowing. At the end of this period there were in Massachusetts alone forest plantations of white pine to the extent of 10,000 acres.

Typical of the forest planters of this time, was Mr. Augustus Pratt, a former member of the State Board of Agriculture, who, when nineteen years old, planted pine seed on an old pasture belonging to his father. The wood lot which thus developed has been recently cut, and was between forty and fifty years old.

After 1880 interest began to decline, chiefly because of the immense supply of lumber brought from the region of the Great Lakes at a low rate of transportation and the inadequate methods of combating forest fires; these conditions tended to gradually dampen the enthusiasm of the forest planter."

Most of the plantations mentioned in the publication were visited by the writer, and the results of the visits recorded, as well as it is possible to record such things, in the subjoined tables. But in viewing stands of timber such as these, there come thoughts and conclusions which cannot be reduced to writing, as well as a deep sense of satisfaction. It is as if the results which you have been striving for, the work which you have been advocating and which cannot be realized more than once in a life time were by one pass of the magician's hands revealed before your eyes.

Cape Cod Plantations.

A study of the plantations of Massachusets would not be complete without mentioning the work done in connection with the reclaiming of the sand dunes at Cape Cod. A visit was made to this area in the spring of 1919 and the plantations were examined to the extent that a part of a day would allow. The work at the Cape, however, is primarily to retard the encroachment of the sand dunes.

In connection with this, the use of trees is being largely supplanted by beach grass and bayberry. The plantations examined, where exposed to the sweep of the Atlantic wind, were a failure, and it would seem that without first stabilizing the sand by some binding growth that such species as Pitch and Jack pine even, could not withstand the punishment which the force of the ocean winds inflict.

A study of this work was made a few years ago by the United States Department of Agriculture, the results of which have been embodied in Bulletin \$ 65 entitled "Reclaiming of Cape God Sand Dunes."

3. DESCRIPTIVE TABLES.

Site Quality I.

No.	Name	Size In Acres	Blanks	Cause of Blanks	Competing Growth	Fecent Weeviled	Snacing	Planting Method	Age	Height
1.	M.Ashburnham 21	8	and the second s	arangan gapan dan saman dan dan di samat dan	Account of the Control of the Contro	A commence of the commence of	8x8	and the companion of the color	5	3
2.	Waterville 19	25	ر در	ad Paragon (and Said) 1985 - 1880 Parago and Parago (and Anthon 1983) of the Said Paragon (and Anthon 1983) of the Said Paragon (and Anthon 1984)	en ausgebiede de state de service de l'antique de l'ancient de la	en film en fermina en	6x6		6.	5
3.	Wachusett 5	4	general and the second		and the state of t		6x6	e de la companya de l	8	6
4.	Royalston 10	5	1/10	engaga, kapangan pangan magangan pendahan kanan pangan pendahan mengangan pendahan pendahan pendahan pendahan	The second secon		6×6		10	
5.	Wachusett 1	10	And the second of the second o	and a consequent attention to the contract of			6x6	The second secon	14	17
6.	Wachusett 21	and a manufacture purposes on a consequent section of a state of a section of the		and the control of th	en e		8x8		15	15
7 .	Wachusett 3		and the second s	og forstadige ungerstadenskip med men er 👫 plane til et kop (i 1. 1. 1. 1. 1. 1.			6x6		15	24
8.	Wachusett ll	1	And the second s	and the second s			10x12		16	25
9.	Wachusett 2	8		an sagarangan an a	granifeld (till) förstligt förstligt förstligande av kennen i en samt en		6x6	and the reformation of the control o	16	18
10.	Wachusett 12	3			and a finish of the second		SIXSI		17	24
11.	Wachusett 4	8		,	and the second s		6x6		17	25
12.	N. Andover	4	ing and the second seco				6x5		17	18
13.	Wachusett 17	4	per grant and the second and the sec				6x6		17	25
14.	Wachusett 18	3					12x15		1.7	20

Site Quality II.

-	and the state of t	Size In Acres	Blanks	Cause of Blanks	Competing Growth	Percent Weeviled	Spacing	Planting Method	Age	Height
1.	Name P.H., C3-30	1/2	2/3	competing herbaceous and woody growth		5	6x6	slit sod on	4	3
and the second seco		1		or and the second secon		5	3x3 to 6x6	3 different	4	1.5
2.	P.H., C3-29	um vienas per es en en al alta esta el alta esta en el alta esta en el alta esta en el alta esta entre el alta entre el alta esta entre el alta entre	1/5	competing herbaceous		15	6x6	side hole	5	3
3 .	P.H., C6-16W	4	1/5	and woody growth		5	6x6	side hole	5	3,5
4.	P.H., C6-16E	T	1/5	and woody growth		55	6x6	mattock hole	17	5
5.	P.H., C8-21 Ashburnham 1	1	and the state of t	growth competing woody growth	and the second s		8x8		8	3
6. 7.		1.5	1/5	competing herbaceous & woody growth	sweetfer hardwood	7	6.x6	mattock hole	9	6
8.	P.H., C1-25 P.H., C3-1	L • V	1/4	ant hill and shade	ger eg er er trett ermit Mikilikarion	35	6x6	mattock hole	9	5.5
		1.5	2/3	competing growth		15	6x6	mattock hole	9	6.5
9.	P.H.,C1-25		1/10			Construction of the Constr	6 x 6	and the second of the second s	9	6
10.	New Boston 16	10	an again ang ang ang ang ang ang ang ang ang an	competing woody	sweetfer blueberr		6 x 6	mattock	10	5,5
11.	P.H., C4-13	7.5	9/10	growth	tussock sweetfer	\mathbf{n}	5x5	hole	11	53
12.	P.H., 02-10] 	2/3	competing woody growth & shade	bluebern tussock				77	100 per construir de la compression de la compre
13.	P.H., C2-3	-3		An appropriate to		5	6x6	mattock hole	11	
14.	Bullardsville	8 2	1/10		ngaga panganan sama sama kalaman na manan na ma	Constitution of the second of	6x6		11	8
1 5.	Bullardsville	9 1	2/3	wind			6 x 6		11	7
16.	Wachusett 10	La commence de la co La commence de la co	gggggggggggggggggggggggggggggggggggggg		And the second s		6 x 6		13	12

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Site Quality III.

No.	Name	Size In Acres	Blanks	Cause of Blanks	Competing Growth	Rescent Weeviled	Spacing	Planting Method	Age	Height
1.	Bullardsville 7	2	1/10	competing growth,	young hardwoods	damentement in Missia como chemica como como como como como como como co	62.6	Arman Alav siggis deligibility deligibility (Arman Alav sigli siggis deliverance au egus	10	And the second desired
2.	Wachusett 10			sour soil			6x6		18	6

SCOTCH PINE

Site Quality I.

No.	Name In Notes	Size In Acres	Blanks	Cause of Blanks	Competing Growth	Planting Method	Spacing	A CC	Height	Additional Notes
1.	P.H.,C6-16	<u>1</u> 4	e e e e e e e e e e e e e e e e e e e			side hole	6 x 6	5	5.5	
2.	Р.Н.,03-3	12	1/3	mice		mattock hole	6x6	6	6	
3.	P.H.,C7-18				blueberry	slit sod off	6 x 6	6	6	
4.	Ashburnham 2	5	1/3	poor stock		mattock hole	6x6	6	4	
5.	P.H.,C3-3	1 2	4/5	mice		17 31	6 x 6	7	9	thick grass beneath trees
6.	Race course 18	10					6 x 6	7	6	trees on actual course average 3' & sickly due to compact soil
7.	P.H.,03-3	1 2	1/3	mice			6 x 6	8	6	
8.	Winchendon 3	40	1/10	mice	d L		6 x 6	8	7	thick grass beneath trees
9.	New Boston 12	2	1/20	mice			6x6	10	8	
10.	Whitney 17	4					6x6	10	12	
11.	N.Ashburnham 2	0 8	1/20	mice			6 x 6	10	11	thick grass beneath trees

SCOTCH PINE

Site Quality II.

	and the second s	man ang ang ang ang ang ang ang ang ang a		T	and the second s	And the state of t					
		Size In Acres				Competing	Planting Method	Spacing	Age		Additional Notes
No.	Name							6 x 6	5	2.5	
1.	New Boston 14	1				Committee of the commit			n to en en talle se en talle se particular de la companya de la companya de la companya de la companya de la c	and the second s	
				and the second s	magento in the control of the second	And the second s		6x6	5	2.5	
2.	New Boston 15	1						in the second second second	J	January and the first	- 1 4 1 1 1 1 1 1
	en e		energia (n. 1920) Santa (n. 1920) Santa (n. 1920)	And the second second		The second secon		6x6	6	3	flat sand plain
3.	Whitney 13	100				ing a second of the second	and the second second second			t	and the second s
		5	egy gy mae s egy a ventra selvat va sa situat selvat selv			:	,	6 x 6	7	3	
4.	Whitney 11		enderge eine eine standen met	The second secon	والمواورة المحاولة والمعاولة والمستريد المراجع المستريد		The residence remarks of the control of	C 7# C	r y	4	
_	Bullardsville		1/15					6x6	; (1	flat sand mlain
5.	Dattaranation	:	•		and the second second second second		. A. am transfer case to the transfer	and the second of the second second	against the same of against their	. 1	

Site Quality I.

No.	Name In Notes	Size In Acres	Blanks	Cause of Blanks	Competing Growth	Planting Method	Spacing	Age	Average Height	Additional Notes
	P.H., C1-26	1/8		The state of the s	heavy grass, aspen	slit sod off	6 x 6	6	8	Larix lep- tolepsis
2.	P.H.,C7-9	1/2		Segmentalistic variety man man de 5 confessionalis à l'anne rennembrais à commune de confession (Castro Manuelle de l'Anne de		variety	8 x 8	6	10	Larix larix
S &	P.H.,C1-24	1/8			witch grass	mattock hole	6x6	7		Larix europeae

Site Quality II.

No.	Name In Notes	Size In Acres	Blanks	Cause of Blanks	Competing Growth	Planting Method	Spacing	Age	Average Height	Additional Notes
1.	, F.H., C5-17	12	<u>1</u> &		mixed woody growth	slit sod off	7x7	5	9	Larix larix
2.	P.H.,05,P.17	3 1/3	<u>j</u> 		TF FF TT	भ्रा मि	7x7	5	8.5	11 11
3.	Wachusett 14	2	Section of the sectio	inger sterr en gransteller en duerstell individual in de la service de la service de la service de la service			6 x 6	15	27	
4.	Wachusett 16			to The second	English make in the second of	and and the second seco	6x6	16	25	And the second s

	The second secon	The second secon	The Administration of the Section Sect		Site Quality III	(·				
No.	Name In Notes	Size In Acres		The state of the s	to be administrative to the projection to a distinct or the projection of the projec	and the second s	and the second s			
7	The second secon			or pranks	Competing Growth	Planting Method	direction of the second	The same of the sa	Average	gg a straigh a geart 1874 at thurst of a fatherful disk morning states a recover for the gas and the filling state
.	P.H., 05-17	28	1 0 1	Rigorous site	And the state of t	inte ctt Od	Spacing		77	Addit ional Notes
	P.H.,C5-17			100 0100	mixed woody growth	slit sod		5	The state of the s	7 1,1,0 tes
1.	and the second control of the second control	- L/()	C. 4	17 11	17 FF FF	off	The second secon	on the committee of	4	Larix larix
				the control of the state of the		Et II	7 _X 7	5	5.5	tt the second se
					,	And the second of the second o	e temporario de escalario de la composição		Orange and Samuel S Samuel Samuel	the state of the s

4. QUESTIONS TO BE ANSWERED.

QUESTIONS TO BE ANSWERED.

How much and to what extent did the various accepted site classes affect the height growth? (height, volume or both).

To answer this question adequately the reader is referred to the subjoined tables.

II. Yield?

To answer this question adequately, the reader is referred to the subjoined tables.

III. What per cent of the total areas examined for each site class was failed?

White Pine

Site Quality I. 0.52

" " II. 29.0

" " III. (12.8) not sufficient number examined.

Scotch Pine

Site Quality I. 9.4 (mice responsible for most of this.)

""" II. 0.3

Larch

Site Quality I. 0.0
" " II. 22.7
" " III. 75.0

IV. What are some of the causes of failure in a forest plantation?

Many questions arise as to what may increase or retard the success of a forest plantation. A long list might be drawn up, but after visiting the hundred odd plantations upon which this study is based, the most important may be gathered under the following headings:-

(a) Nursery and Planting.

It is not intended here to go into the practice of forest nursery work. That is a field which this treatise does not discuss. But let it be said that unless great care is taken at the time the plants are leaving the nursery and being planted, no amount of care and natural favorable conditions will atone for the neglect. There are a number of little things each in themselves of small account, yet taken together in their accumulative effect which go far to destroy the success of the plantation. From the nursery until the plants are in the ground in their permanent site, is a critical stage and demands the greatest possible care from injury and dying out.

Of many plantations visited where the percentage of failures was high, after considering such factors as soil site and location, no other reason could be given for their condition than that of poor stock and neglect.

(b) Other things being equal, does the choice of site within a species botanical range account for many failures?

This is one of the fundamentals of sylvics. Briefly let it be said that a slight difference in site, such as a location which subjected the trees to slightly more shade or moisture

and particularly, wind accounted for many failures. A good example of the effect of wind on the percentage of failure is shown by the larch plantations at Havard on the slopes of Prospect Hill. Where the trees have a moderate amount of protection, they have done well, but as they ascend the hill and are subjected to the sweep of the winds the plantation is a failure.

(c) Does the planting method account for much loss in the plantation?

The influences of the planting method cannot be traced beyond the end of the first year. But during that first year, the plantation may be greatly diminished, if the choice of planting method has not been a wise one. From observations of plantations where records have been kept, the planting method to be recommended is one which allows the roots to hang perpendicular in the hole and which also minimizes the amount of competing growth for the first year.

(d) What effect if any, did the competing vegetation if any, have on the survival of the plantation?

This in the opinion of the writer is the most important cause of failure in forest plantations; and especially so where the tree is a light demanding species. Where the planting is done on thick sod or in long grass, with the commonly used species of pine, and at least eighteen inches is not removed from around the plant the loss is ninety per cent. Other woody growth varies with the species as does also the species of tree planted with different species of competing growth.

(e) To what extent may sour soil be accounted for in the percentage of failures?

By sour soil is meant alkaline soil or stagnant areas of a plantation caused by saucer shaped depressions in the site. This condition has been referred to as "frost pockets". Frost is not to blame here, but the inability of the plants to receive proper nourishment from the soil.

This condition is very noticeable where planting has been done on blow sand where craters have been left by the fancy of the wind. Trees planted in such areas invariably die, not even the tenacious poplar and willow have survived under such conditions when the alkaline condition was severe.

(f) Are trespassing animals responsible for much loss?

The greatest loss of this kind is attributed to mice where long matted grass covers the floor of the plantation, this injury is most imminent. The mice apparently use the tender bark of the young trees for food. Feeding of this kind is done under the snow and in most cases the trees are completely girdled.

During the severe winter of 1918 a number of plantations were injured by this means.

5. THE RELATION OF PLANTING METHOD TO HEIGHTH GROWTH.

THE RELATION OF PLANTING METHOD

TO HEIGHT GROWTH.

In the spring of 1913, Mr. E.B. Carter, then Assistant Professor of Forestry in Harvard University, conducted a number of experiments with forest plantations in order to determine if possible, the relation of planting methods to survival. A description of these experiments and the results obtained were published as an article in the Proceedings of the Society of American Foresters, Volume X, Number 1, Page 9.

In setting out to determine this relationship, Mr. Carter chose for his site a medium to low quality I for white pine, on the basis of Frothingham's yield table. The species he used were; White Pine, Scotch Pine, Douglas Fir, Norway Spruce and Western Yellow Pine. The three planting methods employed are known at the Harvard Forestry School as, the mattock hale, the slit, sod on, and the slit sod off methods.

More complete data about the site, the species used and the planting methods employed, will be found in Mr.Carter's article, but for the purpose of the present writer, it is thought well to describe more fully the planting methods used.

The mattock hole method consists of digging a hole with the mattock and removing all the earth therefrom. The seedling is then carefully planted with the hands, care being exercised in seeing that the roots are perpendicular and that the root collar is at the proper level. The earth is then swept back into the hold and tamped firmly with the hands and closed fists.

with the slit sod off method, "the first act is to cut off at least a square foot of sod, the second to drive the blade of the mattock as deeply as possible with one stroke, and to twist or pull the mattock so as to lift a mass of earth on the blade, thus leaving a hole into which the roots of the seedling are slipped, and the third is to remove the mattock and firm the earth over the roots by one or more vigorous stamps."

The slit, sod on method "is exactly like the second except that no sod is cut off, and the seedling is left with its stem in contact with the grass."

At least one row of each species, with about forty trees in each row, were planted by each of the three methods, and the rows distributed irregularly as regards both species and planting method in order to compensate for any unseen difference in site. The condition of each tree was determined about once a month for two growing seasons and the results recorded in a table which forms part of Mr.Carter's article. It was concluded that the influences of planting methods to survival, cannot be traced beyond the end of the first year.

In the fall of 1919 this plantation was measured by the writer in order to determine if possible, the relation between the height growth of the various species and the planting method employed, after a period of seven growing seasons. Each tree was measured, with a rod, to the nearest half foot and the average height obtained for each row. It

table that there is a great difference between the number of trees recorded for the different planting methods by Mr. Carter and the writer. This is due to two reasons.

A certain number of trees during seven growing seasons become damaged by trespassing cattle, weevils and other causes, and secondly, a number of trees on one side of the plantation have had a hard struggle for existence with competing low woody growth. All of the first named and some of the last were omitted from the calculations because a study of the results due to such competing factors are aside from the work in hand.

The compilation of the height growth figures, shown in the accompanying tables, set forth clearly that after the first year (as concluded by Mr. Carter for survival) the method of planting has little if any relation to height growth. If there is any appreciable difference it is in favour of the mattock hole and the slit, sod off methods. It is obvious, therefore, that for successful planting the first two methods, or methods analogous to them, are to be advised in preference to the slit, sod on method, which fell below the other two, both as regards relation of survival to method, and relation of height growth to method.

SCOTCH PINE .

A STATE OF THE PROPERTY OF THE	property (1/25) and the second description of the second description o							aqu	The second secon	
Planting Method		Mattoc	k Hole		Slit Sod Off		Sli	t So	l On	
Row Number	4	8	21	29	27	14	22	28	31.	3 5
Number Planted	40	41	40	23	37	40	45	39	42	41
Number Included	innerennere aneren : : 52	26	30	34	34	34	22	23	24	33
Average Height	6.53	6.42	6,66	7.26	7.58	5.88	6.40	6.47	6.7	5.63
Total Average Height.		6.7		ggmby, Auddition Comments	7.58			6.21		

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WESTERN YELLOW PINE.

Planting Method	Mattock Hole	Slit Sod Off	Slit Sod On
Row Number	15	37	17
Number Planted	40	39	39
Number Included	T.7	13	19
Average Height	4.70	3,92	3.68
Total Average	4.70	3.92	3,68

NORWAY SPRUCE.

Total Average		.24	3.3	58	3.	03
Average Height	3.13	3.36	3.30	3.46	2.82	3,25
Number Included	. 23	. 22	26	ess paid in the state of the s	17	12
Number Planted	39	43	39	38	41	47
Row Number		4 0	In the second se	36	1.3	38
Planting Method	Mattoel	K Hole	Slit	Sod Off	Slit	Sod On

á

DOUGLAS FIR .

Planting Method	Matto	ck Hole	Slit	3od Off	Slit	od On
Row Number	I. B	33		34	9	26
Number Planted	38	42	40	41	40	41
Number Included	26	28	25	25	21	20
Average Height	3.73	4.07	3.4	3. 56	3.52	3.0
Total Average Height.	<u></u>	t en	3 .	or in an annual management and a second and a	en terreta e anno con contra resemble de la colonia de	,26

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WHITE PINE.

Planting Method	Ma	attoe	k Hol	.0	!	Sandy Control of the	Slit	Sod,C	ff	Slit	Sod	On	- Announce of the Control of the Con
Row Number		To recognition to the second	1,2	25	A silver	3	7	16		24	30	32	39
Number Planted	40	35	38	40	43	40	41	39	20	44	4.6	44	41
Number Included	200	1 179	english anning statement and a section of the secti	5	germanne and enter the state of	· • • • • • • • • • • • • • • • • • • •	City See		Marie garage	8	AND THE RESERVE	5	5
Average Height	4.45	5.0	5.0	6.6	4.57	5.11	5.81	4.8	5.53	5,25	5,63	5.8	4.
Total Average Heigh t	5.12.				de acamemor activo o meno vivinencia.	5.31			n neen vaganagaasi miista ka ka maanaada	5 _* 22			

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6. YIEDD TABLES.

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YIELD TABLES.

The following tables were compiled in order to show the comparative yield of certain forest plantations with natural stands of the same species and age.

The abbreviations - Mass., Froth.

and Margolin, refer to yield tables for White

Pine compiled by the Massachusetts State Forester,

Frothingham and Margolin respectively. The

other names refer to plantations described in the

bulletin entitled, "The Older Plantations of

Massachusetts, Conifers."

YIELD PER ACRE, PURE EVEN AGED WHITE PINE SITE QUALITY I

Plantation or table	Age	Av.ht.	of av.	No.of trees per ac.	Spacing	Cubic feet	В.М.	
Sp.Pt.#I	34	50	10.5	352	10x10.	and the second s	29,212	
Spl.pt.#4	34	60	5 *	648	loxlo	nderde en	26,760	
Mass.	. 35	TO THE PROPERTY OF THE PROPERTY OF THE PROPERTY AND THE P		old April model weet 1951 - geglenthe the many conservation in processor in -	«Андинический от неменений подписа на	TT We did the Artifact of the sequence of the second probability and probability and the sequence of the seque	31,1 50	
Froth.	35	53	7.5	710	and the second s	5200	er in francische sprache in 19 February (1996) der gegen gegen gestellt der der der der der der der der der de - -	
Margolin	35	48	alle til state fra til 1 sjennessy flygighet til den enne gåd at englighet en enne gåd at englighet en enne en			5850	in Titlere, Weden without in Commission of account TATA (SMAPP) And Admission of Management (Smapp) of the Smap 	

YIELD PER ACRE PURE EVEN AGED WHITE PINE SITE QUALITY II

Plantation or table	Age	Av.ht.	d.b.h. of av tree	No.of trees per ac.	Spacing	Oubic feet	B. M.
Spl.Plot 3	34	60	7	440	10%10		22,880
Mass.	3 5			godining manager of primite the conducting place of the consistent	AND THE CONTROL OF TH		24,40
Proth.	55	44.4	6 .1	950	en e	4180	
Margolin	SSE	4.5	ryymmynog erwygyn ww. niwn i rus lladdidd yr 1999 o edigwenn (dd 14 ddi		Manufachan (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996) (1996)	4850	, yangi danggala Militari ya mamadi pililiki Milijani gilir oo oo oo
Spl.Plot l	A SAN	Company of the Compan	11.5	332	10x10	og og gregorien er skriver i gregorien er skriver i skriver i skriver i skriver i skriver i skriver i skriver i Skriver i skriver i	37,71
Spr.Plot 4	43	65	6	6 648 10		anganggan anamo nyaétaga namonton na anan metabahaha	38,68
Mas s	45	helike ji liha wanana ana firmera ambirisi isa 1800 200 Milita jimaa wir-ari 2002 Mi		د در	орожи вого о общегорожний — просорожения — по очено в 1000 година изований		40,60
Froth	45	58	8	635	Milliam March, 1974 d = Carteri von der registrick en Schafferen (n. 1 Schaffe)	6100	
Margolin	45	59		OF FEB. POST DESCRIPTION CONTRACTOR OF THE STATE OF THE S	ком не на применения приме	6600	need beeeggenesses sammales i soonneed i Maries sammales en

YIELD PER ACRE PURE EVEN AGED WHITE PINE

SITE QUALITY III.

Plantation or table	Age	Av.ht.	d.b.h. of av. tree	No.of trees per ac	Spacing	Cubic feet	Belle	
Sp.Plot #2	34	50	9.5	264	loxlo	and an extension of the Control of t	19,640	erenet (e dere en sempens minimo de de desert
Mass	35	The second secon		The second second second		Maria de la companio del companio de la companio de la companio del companio de la companio del la companio del la companio de la companio del la companio de la companio d	16,950	en a desperanta de la seguida
Froth	35	36	4.7	1400		3100	manufacture and the	Commence of the second of the
Marg.	35	42		فيناه والمتعلق والمتعلق والمحافظ والمتعافل والمتعافل والمتعافل والمتعافل والمتعافل والمتعافل والمتعافل والمتعا	den Geschier von der von der till til den der den	3850	et en	e artise artise escape escape and assume
Dean	38	50	go and a community of management of the community of the	250	loxlo		29,000	kan terapa (a. 1924), a terapa Antika (a. 1924), a terapa (a.
East Bridge	39	50	8	452	8x10	And the second responds to the second first the second	24,428	ne van vagen i Lande e
Kilburn	41	55)	9	325	6x8		25,934	
Mass	40			entrem en ligengo, o pameios en enemos e referencios	e e de la companya d Indiana de la companya de la c	and the second s	25,200	ME AND REPORT OF A PARTY OF
Froth	40	42.5	5.5	1118		3780		and the state of the same of
Margolin	40	48	The state of the s	A province of the second	· · · · · · · · · · · · · · · · · · ·	4567		rendere i de la como
Sp.Plot #2	43	55\	10,5	264	\10x10	k Turme (1994) in en me _{more} kande per en deze egen generale egen de sjok Si Gilling (1994) herman kenden kritisk er kommer gan einig kandigsbyde t	26,742	ا می از این از این از این
Sp.Plot #3	43	65	8	440	loxlo	and the second	33,080	i do qor qosoo qayayay q
Albea	46	42	10.4	315	loxlo	Tokan mengeneral and Proposition producting and the Confession Security and the Confes	31,780	et eterribera tibare esc
Mass	45	The state of the s	manayan in mayangan masayan ay alamayan ay managan ay	e er ett ide stor _{de} umstant til _e t um tittettigt er titt		ا در در این در در این در ای	32,100	enematical estimates and the second second
Proth.	45	48.5	6.3	900		4500	All and the territories and the second secon	Natural Sensitivity (1984)
Marg.	45	54	ter team, before given, accessors /m. e.g. e.g. , action to continuous et al	للمنافرة المقادمة والمنافرة والمنافر	Productive and an international management and a productive and a producti	5200	en general de la companya de la comp La companya de la companya de	te til til kalandar af til för ett af elle för
Cook	50	51	10	460		a disensi ing nga mga palamata a sake wa mana ka sake sa isanak Rapanga ing nga mga palamata a sake wa mana ka sake sa isanaka a isanaka	34,927	ata eta eta erreken erreken arreken barra (h. 1921). Pala eta eta eta eta eta eta eta eta eta et
Mass	50		the mail is not moved, it, then is given the property and the section of the sect	and granted productions of the control control of the first of the fir	Pages and all the last testing properties and properties and consequences of the last testing of the last	there was the first and the state of the sta	37,550	den des transfer de la companya de
Froth	50	54	7	764	ار بروز بر بر در	5200		and a distance and commission considers on
Marg.	50	60 T		errent bez e Miller beg er e roki g (12) - 20) ze i bez gi	o to the description of the second of the se	5833		ag gesteradan kiteli az
Douse	55	50	11	480	8xI0	و من المحافظ المحافظ المحافظ المستمثل المستمد المحافظ المحافظ المحافظ المحافظ المحافظ المحافظ المحافظ المحافظ المحافظ المحافظ	45,654	баттын Төөсүтү, алуыну алуы алуы Төөлөл бай алганын өзүнүү алуыш
Fobes ·	56	70	11	254	and the second s	والمساورة والمراورة والمراوية والمراوية والمراوية والمراوية والمراوية والمراوية والمراوية والمراوية	38,464	ong sambing you are enjoyed as
Mass	55	و مع این او به ۱۰ ماری در ۱۰ تاریخی ۱۱ به پیدا داشت	ent i grapa parente esta en	- स्थर प्रतासन्त्र प्रतासन्त्र स्थापना स्थापना स्थापना स्थापना स्थापना स्थापना स्थापना स्थापना स्थापना स्थापना स		Territories de descripción de la company	42,100	and the specified specified with the second
Froth.	55	58	**************************************	639	المراجعة الم المراجعة المراجعة الم	5870		enti (Tibikeenska finis (Serigea, Teis
Marg.	55	66	20 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1900 - 1	t de tament de la grande de la completa de la comp		6375	The state of the s	الراد و الاحتمال المحتمل المحت
remote programme to the programme terms of the first programme to the programme terms of the programme terms of	ر الله الله الموادد الله المساورة الموادد الموادد الموادد الموادد الموادد الموادد الموادد الموادد الموادد المو الموادد الموادد	en grand at majorgania agrapa kalab majorgania kanang paga saga tanah panah majorgan	en e	e de la caractería (por la caractería de l Destrucción de la caractería de	t y a transmitte per site and another section of the section of th	المراجعة بالمراجعة المراجعة ا والمراجعة المراجعة ا	ga mindre edin di sinni yana yani hari su armiya du armiya ku armiya ku armiya ku armiya ku armiya ku armiya k ga armiya ku armiya armiya armiya armiya ku armiya	는 기계등은 건 보는 100 분 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km) 등 100 km (100 km) 등 100 km) 등 100 km) 등 100 km (100 km) 등

YIELD PER ACRE PURE EVEN AGED WHITE PINE

SITE QUALITY III.

Plantation or table	Age	Av.ht.	d.b.h. of av. tree	No.of trees per ac.	Spacing	Gubic feet	B • M •
Kilburn	60	60	Mary Andrews Control of Control o	383	63.8	program annual programme annual programme annual programme annual programme annual programme annual programme a T	43,620
De an	61	E ()	THE STATE OF THE S	266	loxlo	Been visit State of Masters Ma	41,000
Mass	60	gereiningen (de kontrol (d	Company (Andrew Programming Company Andrew Parties of Company (Andrew Parties of Company)	ge yn felydrog gyfaedig felib 1997 olle Malestaniae annae Milletherio (Cilletherio	Terre (1976)		
Proth	60	64	8.6	543		6530	
Margolin	60	T L	dynamicaniana, MTroffilia udviktorudvanovalar on di Korell	дауулганда таман тамада үүн соонын айна с 1110-ж дауун анаа	ensu krimirus († 1401–1744) en erikus († 1475) – franklik († 1465) en erik († 1465) en erik († 1465) 1	6900	y gypgynggyn i sermu sy kalu siguegos yn roenn meassag aenendage Miller (7

7. FHOTOGRAPHS AND MAPS.



(Figure 1)
WACHUSETT RESERVOIR:
North slope.



(Figure 2)

WACHUSETT RESERVOIR:

Showing White Pine plantations and protected stream bed. View looking south near North Dike.



(Figure 3)

WACHUSETT RESERVOIR:

Locust and White Pine Plantations.



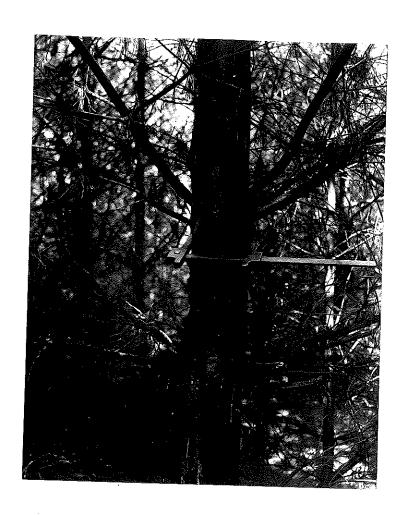
(Figure 4)

WACHUSETT RESERVOIR:

White Pine Plantations, interior view. Trees 25 feet high, 17 years of age.



(Figure 5)
WACHUSETT RESERVIOR:
General view.



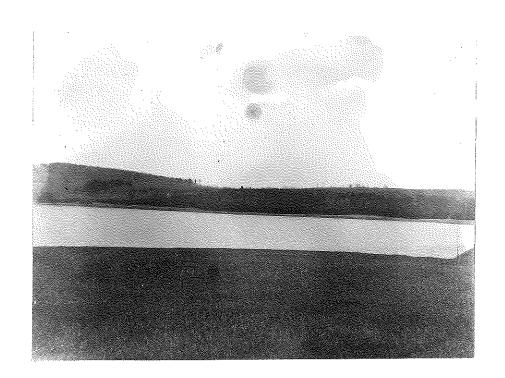
(Figure 6)

WACHUSETT RESERVOIR:

White Pine, 18 years old, 5\frac{3}{4} inches D.B.H.



(Figure 7)
WACHUSETT RESERVOIR:
Marginal View.



(Figure 8)

WACHUSETT RESERVOIR:

Marginal View from North Dike.



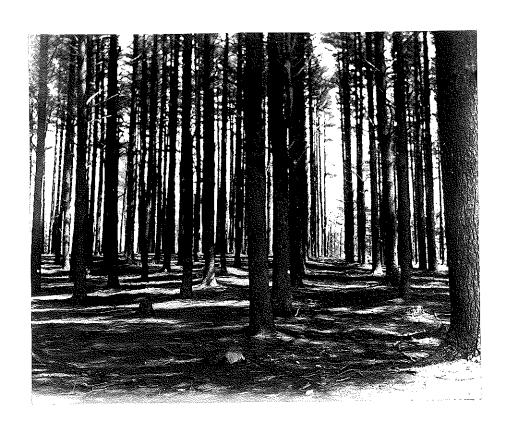
(Figure 9)

WACHUSETT RESERVOIR:

Marginal View, showing protected margin, Cedar wall and White Pine plantations.



(Figure 10)
WACHUSETT RESERVOIR:
Norway Spruce Plantations.



(Figure 11)

SHARON, MASS.

White Pine 62 years of age.



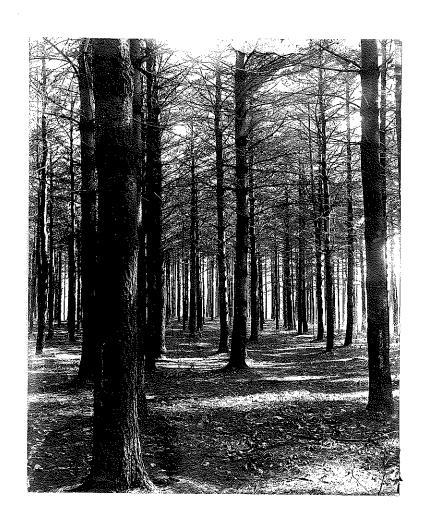
(Figure 12)
SHARON, MASS.
White Pine 62 years of age.



(Figure 13)

BRIDGEWATER, MASS.

White Pine, 50 years of age.



(Figure 14)
SOUTH LANCASTER:
White Pine 47 years old.



(Figure 15)
NORTH ANDOVER:
White Pine 17 years old.



(Figure 16)
NORTH ANDOVER:
White Pine 17 years old.



(Figure 17)
WINCHENDON, MASS:
Scotch Pine 8 years old.

