FORESTRY THESIS.

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A report on Comparative Rotations for Pulpwood and Turpentining in Southern Pine submitted to the Department of Forestry and Conservation of the University of Michigan as partial requirement for the Masters Degree in Forestry.

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S.K.Hudson
Fernandina, Fla.

OUTLINE.

I. Purpose

II. Data

III. Procedure

IV. Explanation of Turpentining

V. Explanation of Tables and Charts

VI. Discussion

VII. Summary

PURPOSE.

The purpose of this problem is to determine whether it is financially advisable to turpentine trees for their full turpentine life of 14 years of to turpentine them for only 8 years before cutting them for pulpwood. This matter could be discussed pro and con for hours. I have tried to present a complete picture of figures to show what actually would occur on two such rotations. The summary of these figures in dollars and cents to be the basis of any discussion.

In addition I have developed a series of diagrams which should aid in evaluation of any turpentining project. These diagrams once constructed are suitable for any valuation of property based on that turpentine plan.

DATA.

* All data used in this work is based on actual conditions as found by my associates and myself in cruising a tract of 18,000 acres of Southern Pine. The data regarding values of turpentine faces is representative of average conditions in Florida.

The growth data was compiled from increment borings made during the cruise. Similiarly, mortality data is based on actual studies made by us.

Value of a "Turpentined-out Tree" for pulpwood - 10¢. This is based on an allowance of 10 trees, 10" dbh to make one unit (160 cu. ft.) of pulpwood worth $1.00 per unit stumpage.

Value of turpentine faces.

A first year face is worth 3¢ for the year.
A second year face is worth 3¢ for the year.
A third year face is worth 2.5¢ for the year.
Fourth, fifth, and sixth year faces are worth 2¢ per face per year.

This series of 6 faces may be repeated on the opposite side of the tree after a 2 year rest period.

I have determined that turpentine operators would pay the following prices per year per face for a 8 year turpentine period without a rest period:

A first year face - 3¢ for the year.
A second year face - 3¢ for the year.
A third year face - 2.5¢ for the year.
A fourth year face - 2¢ for the year.

Then, without resting the tree, if the present face is abandoned and the opposite side of the tree boxed, the price per face per year will be the same as for the preceding face.

Cruise Data per Acre - 18,000 acres:

STOCK AND STAND TABLE

Longleaf; Diameter class.	-ROUND TIMBER- No. Trees per Acre.	Slash Pine; Diameter Class.	No. Trees per Acre
3"	10.3	3"	9.8
4"	5.0	4"	4.3
5"	5.4	5"	4.2
6"	4.2	6"	3.4
7"	1.8	7"	1.8
8"	1.5	8"	1.1
9"	.8	9"	.3
10"	.2	10"	.1

-TURPENTINED TIMBER-
(Species combined)

No. Trees per Acre.	Condition of Present Turpentine Face.	Years left in First Face.	Years of Rest.	Years Left in Second Face.
~~10.1~~ 10.1	Turpentined Out	0	0	0
1.6	1 old face - 0 new face	0	0	6
.8	0 old face - 1 yr. new face	5	2	6
.4	0 old face - 2 yr. new face	4	2	6
.5	0 old face - 3 yr, new face	3	2	6
.07	0 old face - 4 yr. new face	2	2	6
.5	1 old face - 1 yr. new face	0	0	5
.6	1 old face - 2 yr. new face	0	0	4
1.2	1 old face - 3 yr. new face	0	0	3
.1	1 old face - 4 yr. new face	0	0	2
.4	2 old face - 1 yr. new face	0	0	5
.5	* 2 old faces* 2 yr. new face	0	0	4

*At one time it was the practice to place 3 turpentine faces on a tree. Government experiments have proven this to be unsatisfactory, however.

GROWTH AND MORTALITY DATA:

Present Diameter	in 5 years			in 10 years			in 15 years			in 20 years			in 25 years		
	Growth	Diam-eter	Mort-ality	Growth	Diam-eter	Mort-ality	Growth	Diam-eter	Mort-ality	Growth	Diam-eter	Mort-ality	Growth	Diam-eter	Mort-ality
LONGLEAF:															
3"	1.5"	4.5"	90% *	1.4"	5.9"	89%	1.3"	7.2"	94%	1.3"	8.5"	95%	1.2"	9.7"	97.5%
4"	1.4"	5.4"	85%	1.3"	6.7"	94%	1.3"	8.0"	95%	1.2"	9.2"	97.5%	1.2"	10.4"	97.5%
5"	1.4"	6.4"	89%	1.3"	7.7"	97.5%	1.2"	8.9"	97.5%	1.2"	10.1"				
6"	1.3"	7.3"	94%	1.3"	8.6"	95%	1.2"	9.8"	97.5%						
7"	1.3"	8.3"	95%	1.2"	9.5"	97.5%	.9"	10.4"	97.5%						
8"	1.2"	9.2"	97.5%	1.2"	10.4"	97.5%									
9"	1.2"	10.2"	97.5%												
SLASH PINE:															
3"	2.4"	5.4"	90% *	1.9"	7.3"	90%	1.6"	8.9"	95%	1.4"	10.3"	97.5%			
4"	2.3"	6.3"	85%	1.8"	8.1"	92%	1.5"	9.6"	95%						
5"	2.0"	7.0"	90%	1.7"	8.7"	95%	1.3"	10.1"	95%						
6"	1.8"	7.8"	92%	1.6"	9.4"	95%	1.3"	10.7"	95%						
7"	1.7"	8.7"	95%	1.4"	10.1"	95%									
8"	1.5"	9.5"	95%	1.3"	10.8"	95%									
9"	1.3"	10.3"	95%												

* This low mortality figure for the 3" stock is used because in cruising we only counted the 3" stock which we thought would survive to reach 4".

Procedure:

In developing a presentation of my plan, I have followed many leads. The present system of presentation is the combination of many ideas. I tried use of Normal Control Tables developed from Miscellaneous Publication # 51. Their use has has commendable merit but are not practical because the present understocked forests would require too much holding back of timber to build up a normal basal area per acre. Too, With fire protection, the forests are going to develop toward a normal basal area so fast that it will be astonishing. Since, a normal basal area will develop so fast anyway, I see no need of foregoing present income to help out the future forest - which in 25 years will need no help. If we goe ahead and turpentine and cut trees at 9" dbh without reserving any, we will have a better forest at the end of that time than if we reserved a portion of the stand for the future.

My problem has 3 classes of forms of income. The long rotation I refer toe is based on about 25 years for a longleaf to reach 9" dbh or turpentine size and about 20 years for Slash to reach 9". The extension or longer part of the rotation comes in in the 14 years of turpenting as compared to the 8 years of the short rotation - the growing period remaining the same in both rotations. The two forms of income being, then, the income from the long rotation and the income from the short rotation. The third class of income is represented by the timber that is being turpentined at present. Each class of income is divided into pulpwood and turpentine income.

The timber that is being turpentined at present is scattered throughout the property-analgous to a one year

turpenting or cutting cycle. The foregoing is an important point - this income is not restricted to one out of 5 acres but comes from all 5 acres of a representative 5 year turpentining cycle. This data is diagrammed on Chart # 3.

The timber that is to be turpentined is, of course, virgin or round. This is to be worked in area groups - 1/5 of the area each year. Thus the turpentining cycle is the same as a 5 year cutting cycle which will follow it. At the end of 5 years the entire property will be under process of turpentining. This will include the two types of turpentining - the group that was previously turpentined and so scattered over the property and the new system which will install new faces on 1/5 of the whole area each year.

This turpentining cycle is similiar to a cutting cycle in that you go onto 1/5 of the area each year; It is different from a cutting cycle in that once an area is turpentined or boxed it continues producing income for a number of years, not for just the year in which the area has faces installed. The foregoing is important - once an area is put into turpentine faces it will continue annual production. The cutting cycle will return in 5 years to install new faces but the old faces have continued and will continue to produce. This makes for an annual income from each cutting area.

The long rotation is diagrammed on Chart # 2. The Short rotation is diagrammed on Chart # 1. With appropiate lettering and references, and full knowledge of the 5 year cutting cycle- annual income relation, I believe these charts will speak for themselves. These same charts are useful for any evaluation based on the turpentining concept.

Having developed the diagrams as an aid in portraying the income and, also, as an aid in summarizing the annual income, Tables # 4(the long rotation), # 3(the short rotation), and # 5(the present t urpentined timber) are developed from the diagrams. These tables show the annual income from turpentine and from pulpwood of each species of pine (P.caribea and P. palustrus). The income from present turpentined timber is grouped; that is , species are not separated.

These tables are next summarized to show the combination of species to produce turpentine income and pulpwood income.and discounted at 4%. This summarized, discounted income data for the different rotations and present turpentined timber is transferred to charts # 6 & 7. Here it is developed to show it's value based on the cruise data for the next 85 years. Finally, all data for the short rotation and all data for the long rotation are boiled down to one figure for each rotation as basis for comparision. The income from turpentine and the income from pulpwood are kept separate until the last as further food for thought,

Explanation of Turpentining:

Government experiments have shown that it is not profitable to turpentine a tree less than 9" dbh. Also, best results have been obtained by not turpentining one side of the tree over 6 years. This should be followed by a two year rest period and then the other side of the tree may be turpentined for 6 additional years, making a total of 12 years of turpentining and 2 years rest. The tree is then actually tied up for 14 years. This is the present general practice followed by the turpentining industry.

A one year face on a previously round tree is referred to as a virgin face. ~~Th~~ At the end of the turpentine seasonthe cup and gutter are moved to the top of this virgin face and in the spring the second year face is started. The process is repeated for the 3rd, 4th, ~~and~~-5th and 6th years, altho, the gutter and cup are not necessarily raised, Following the two years of rest and growth, if any, by the tree this process is repeated on the opposite side from the first face.

When a tree has been turpentined as long as the operator deems advisable (usually the 14 years), its turpentine life is ended. Then, it is referred to as "turpentined-out". It is in this form that it is usually cut for pulpwood.

It is my plan to turpentine one face only four years instead of the usual 6 years, allow no rest period, and turpentine the second face for 4 years. The turpentine operators will pay on the same scale and the tree is then tied up for only 8 years instead of 14 years. At the end of the first rotation this plan effectively increases the producing area

by 6/39; therefore, income is increased by 6/39 with the same cost per acre.

This choice of 8 years of turpentining instead of ,say, 6 or 10 years is based on the fact that it is probably not advisable to turpentine a tree over 8 years without a rest. It is this unproductive rest period I want to avoid. Also, it is easy to see that it would be advixable to hold a tree 2 more years for 4 cents. This being my reason for not using a 6 year period or less instead of the 8 year period I have used.

Explanation of Tables and Charts:

Chart # 1:

This is the diagram of the income based on 8 years of turpentining and then pulpwood removal - the short rotation. The number of trees per average acre of longleaf are shown on the extreme left and also classified as to present condition. These figures of trees per acre are from the Cruise Data Table # 1 in which mortality and growth predictions have been considered. On the extreme right is similiar data for slash pine. It was not necessary to separate these species but I did so because I thought something interesting might develop.

Under 1938 is shown one bar in horizontal column # 1 which is worth 3¢ and is for 1 tree, 1 bar x 3¢ x 1 tree = 3¢, which is recorded on Table # 3 under longleaf. In 1943 there are 3 bars in the 3¢ class, 1 bar in the 2.5¢ class , 1 bar in the 2¢ class. Reading to the left, these values are for one longleaf tree per acre or to the extreme right, these values are for .4 of a slash tree per acre. Also, there is one 3¢ bar for 1.5 longleaf or for 1.1 slash.

1 longleaf/acre x 3 bars x 3¢ = 9¢
1 " " " x 1 bar x 2.5¢ = 2.5¢
1 " " " x 1 bar x 2¢ = 2¢
1.5 " " " x 1 bar x 3¢ = 4.5¢
TOTAL - - 18.0¢, which is recorded in Table # 3 as turpentine income from longleaf for the year 1943.

Similiarly:

.4 slash trees x 3 bars x 3¢ = 3.6¢

.4 slash trees x 1 bar x 2.5¢ = 1¢
.4 " " x 1 bar x 2¢ = .8¢
1.1 " " x 1 bar x 3¢ = 3.3¢

TOTAL - - -8.7¢ which is recorded in Table # 3 as turpentine income from slash for the year 1943. The grand total of longleaf and slash income - 26.7¢ - is also recorded.

In 1952 the stand has advanced and we are cutting on the second-cycle trees. For longleaf, for trees per acre at the extreme left we find 1.5 trees which have a one 3¢ bar, one 2.5¢ bar, one 2¢ bar and a removal dash worth 10¢.

Continuing on down, we find the present 7" trees are to be turpentined and that there are 1.7 trees of longleaf per acre. This time there are three 3¢ bars, one 2.5¢ bar, and one 2¢ bar. Therefore, the income from longleaf on a short rotation for the year 1952 is:

1.5 trees x 1 bar x 3¢ = 4.5¢
1.5 trees x 1 bar x 2.5¢ = 3.7¢
1.5 trees x 1 bar x 2¢ = 3.0¢
1.7 trees x 3 bars x 3¢ = 15.3¢
1.7 trees x 1 bar x 2.5¢ = 4.1¢
1.7 trees x 1 bar x 2¢ = 3.4¢

TOTAL - -- 34.0¢ which is recorded on Table # 3 as turpentine income from longleaf for the year 1952.

The removal dash indicates that there are 1.5 trees turpentined out and ready to be cut for pulpwood at 10¢ per tree - 1.5 trees x 1 removal dash x 10¢ = 15¢ which is recorded as pulpwood income from longleaf in the year 1952 on Table # 3.

The same values are obtained for slash for the year 1952 by multiplying the bars by the number of trees per acre (as shown on the extreme right). This data is then to be copied

on Table # 3 as income from turpentine and pulpwood from slah pine in 1952.

Explanation of Chart # 2:

This is the income diagram of present round timber as it is turpentined or cut on the long rotation. Its mechanics are the same as those of Chart # 1 except that the rest period is included and 4 more years of turpentining as well.

Reading for the year 1952, we find :
for Longleaf pine, one 2.5¢ bar, three 2¢ bars, and one removal dash, all for one tree per acre (fromthe extreme left). For 1.5 trees per acre, we find two 3¢ bars, one 2¢ bar, and the balance being in a state of rest. For 1.7 longleaf trees we find, two 3¢ bars, one 2.5¢ bar and two 2¢ bars. This totals up to a turpentine income of 41.8¢ for longleaf and is recorded on Table # 4 as longleaf turpentine income for the year 1952. The removal dash indicates 1 tree per acre @ 10¢ for a total pulpwood income of 10¢, recorded also on Table #4 as longleaf, pulpwood income.

Explanation of Chart # 3:

This is a diagram of the income from both species combined from turpentining and pulpwood removals. It is a continuation of the present turpentining practice which will be carried to a finish as it started. The number of trees per acre and condition of turpentine faces are from the cruise data. The condition of faces at the present control the length and value of the diagrams.

In order to keep everything on a 5-acre basis I have to put 5 bars in any one year. This is because all of the acreage in a representative 5 acres is being turpentined in contrast to my new system which will start turpentining one acre of 5 acres each year in order to obtain an approximate equal annual removal for pulpwood.

This data is the same regardless of what rotation is used with the present round timber. It is transferred to Table # 5. Appropiate symbols at the bottom of this chart explain the diagrams.

Explanation of Table # 3:

This table is the income from present round timber as it matures for turpentining and is turpentined out. It is ~~the~~ merely the written story of Chart # 1. All figures are obtained as was explained in the explanation of Chart # 1. These figures are listed separately for longleaf and turpentine and longleaf pulpwood income; for slash turpentine and slash pulpwood income. Then both species are totaled together as for turpentine income and for pulpwood income. These totals are then discounted to the present at 4% -(1.04^1, 1.04^2, 1.04^3, etc.).

The discounted, totaled turpentine income and discounted, totaled pulpwood income are transferred to Table # 7.

Explanation of Table # 4:

This is the table of income from present round timber on the long rotation. It is controlled by the diagram of Chart # 2. After treating Table # 4 as was Table # 3, the summarized, discounted income is transferred to Table # 6 for further development.

Explanation of Table # 5:

This table is the income from the present turpentined timber i.e.,timber which was in the process of being turpentined when we bought this property. The figures are obtained from Chart # 3.from which the summarized income was transferred. The summarized discounted income is transferred to Tables # 6 & # 7. It is to be noted that regardless of lengthening or shortening of rotations, this present turpentined timber is not affected. Therefore, it fits equally into either rotation and has the same and identical effect, influence, and values in both rotations.

Explanation of Table # 6:

This table is a summary of the discounted income from Tables # 4 & # 5. Based on the long rotation, this table contains the discounted turpentine income from both the present round and present turpentined timber and also the pulpwood income from the same sources.

The income from pulpwood and from turpentining is shown separately and then totaled together,(columns 4,&8 & 9). Also, the discounted income for the next 25 years is summarized into one figure(col. 12).

The previously discounted income of the year 1962,$1.469, per 5 acres(last figure-col.9) or 29.4¢ per acre, is capitalized at 4% (29.4/4%) to obtain a capitalized land value for today based on income of 1962. To this capitalized land value (col. 14) is added the discounted income (col. 13) for the next 25 years in order to get a total value per acre. $12.55 (col. 15).

The cost value of the property is found by accumulating the annual carrying charges at 4% and discounting this to the present $\left(\frac{45¢(1.04^{25}-1)}{4\% \times 1.04^{25}}\right)$. or $7.04 per acre. Adding the original cost of the land per acre to accumulated, discounted carrying charges, a Cost Value of $11.79 is found(col. 16).

The difference between Cost and Sale Value (76¢) shows profit above expenses, and interest on both original investment and subsequent expenses. This figure of 76¢ will serve as a basis of comparison and contrast to one similiarly arrived at from the short rotation.

Explanation of Table # 7:

This table is a summary of the discounted income from Tables # 3 & # 5. Based on the short rotation, this table contains the discounted turpentine income from both the present round and present turpentined timber, and, also, the pulpwood income from the same sources.

The income from pulpwood and from turpentining are shown separately (col. 4 & 8) and then totaled (col.9). These annual discounted incomes are summarized into total incomes (col.10, 11, & 12). Column 13 shows the total, discounted income for the next 25 years.

The discounted income of the year 1962, $1.45 per 5 acres (last figure, Col.9) or 29¢ per acre, is capitalized at 4% (29¢/4%) to obtain a capitalized land value of today based on income at the end of the period (1962). The summation of discounted income is added to this capitalized ~~income~~ land value (col. 13&14) to get a total gross land value per acre of $13.21 (col. 15).

The cost value per acre is found by accumulating and discounting the annual carrying charges $\left(\frac{45¢(1.04^{25}-1)}{4\% \times 1.04^{25}}\right)$ or $7.04. To this is added the original land cost per acre to obtain a total cost value per acre of $11.79.

The difference between cost and sale value of $1.42 (col. 17) shows profit above all expenses and interest at 4% on the original investment and on subsequent annual expenditures. This figure of $1.42 serves as the basis of comparison and contrast with a similiar one from the long rotation of 79¢.

DISCUSSION:

In my mind these diagrams and tables serve a two-fold purpose: One serving as a method of evaluation of land for a prospective purchase. A set of diagrams being made, the number of trees per acre may be changed as is necessary to fit different tracts of land being considered. This applies as long as the turpentine plan is the same. The value of diagrams being, as I see it, to eliminate carrying too many figures on one's head and, also, simplification of the process of evaluation.

Table # 6 of the long rotation, columns 15 & 16, Cost and Sale Value, reasonably shows tha tthis purchase is a safe investment. Also, it may be seen that annual income over a 25 year period will not be sufficient to meet annual carrying charges (unless prices advance). That is, the accumulated, discounted carrying charges ($7.04) amount to more than the summation of discounted income ($5.20). The only reasont then that this will prove to be a profitable investment is the appreciation per acre.

Appreciation per acre is shown by the difference in Cost per acre and the discounted Capitalized Value ($7.35 - $4.75 = $2.60). Thus it is seen that in a 25 year period, thisproperty will appreciate $2.60 per acre - today's value. Actually, appreciation will be much larger than this because of fire-protection which will bring in new crops which will mature at the same time that the crop upon which the capitalized value is based matures.

Therefore, I have developed a system of evaluation that shows how the income is produced, whether turpentine or pulpwood; when the income is produced; and a reasonable method of

TABLE # 8.

COMPARISON OF INCOMES FROM DIFFERENT ROTATIONS.
(From Tables # 6 & 7)

	Long Rotation.		Short Rotation.
Discounted Income per Acre:			
Turpentine - -	$3.54	←12¢ difference	$3.42
Pulpwood - - -	1.66	48¢ difference →	2.14
Total:	$5.20	36¢ difference →	$5.56
Capitalized Land Value: (Income of 1962, discounted and capitalized)	$7.35	←10¢ difference	$7.25
Total Sale Value:	$12.55	26¢ difference →	$12.81
Cost Value per Acre:	$11.79		$11.79
Net Return per Acre on the Investment over and above annual expenses and compound interest at 4% on the same:	$ .76	26¢ difference →	$1.02

showing an appreciation value per acre. That last fact is important because it is a hard matter to show a definite dollars and cents appreciation value altho one is known to exist. In this case, this appreciation value was the thing that swung this purchase froma negative to a positive malue per acre.

You will say that this evaluation is nothing new and I agree, it isn't new, But I do maintain that the use of the simply constructed diagrams simplifies the process of evaluation greatly and helps prevent errors. If you don't believe it, try to value this property by use of $\frac{r(1.0P^n - 1)}{.0P \times 1.0P^n}$ where and r is also variable. n may be 1,2,3 or more years, My point being, it is hard to visualize the rise and fall of income from face to face and to carry out the variations to a total. The diagrams simplify this process greatly. So much for the evaluation merits which I claim for this system of diagrams.

The real meat of this problem, in my opinion, lies in the difference in income from the short rotation and the long rotation. It is beyond the scope of this paper to maintain that one rotation is preferable to the other. Any preference being determined largely by the woods policy of the company and the supply of pulpwood. It is the field of this paper merely to present the data as food for thought. Application, I repeat, must depend entirely on the policy of the company.

From Table # 8 it is to be seen that the long rotation has a 12¢ per acre advantage over the short rotation from turpentine income or an average higher discounted annual value of .77¢ per acre per ~~acre~~ year - a = $\frac{12¢(4\% \times 1.04^{25})}{1.04^{25} - 1}$. Thus, from the

turpentine income angle, the longer rotation is preferable.

Analyzation of pulpwood income shows a higher discounted income value per acre from the short rotation of 3.08¢ per acre per year - $a = \frac{Co(4\% \times 1.04^{25})}{1.04^{25} - 1}$ where Co = 48¢. This is a total higher discounted income of 2.3¢ per acre per year. This would run into $818 per year of discounted revenue from this property. Thus from figures based on the next 25 years, the shorter rotation is preferable financially because it gives $818 more annual income.

The capitalized land value of the longer rotation at the end of 25 years is somewhat higher than that of the shorter rotation. The cost value of any acre by either rotation is the same. The difference between Sale Value and Cost Value per acre indicates an advantage of 26¢ per acre in favor of the short rotation. This comparison must be carried further, however, to be of salient signifigance.

Having valued the property on a 25 year basis, I begin to wonder what would happen thereafter. It is a very uncertain proposition to predict the stand forward any more. In fact, any prediction based on a stand condition is only a poor estimate, most indefinite, and certain to be too conservative. (Fire-protection being the basis of this statement).

Consequently, I tried to determine the income per tree and cost per tree, Here, on the cost study, I run into stand condition again. The annual carrying charge per acre is fixed; The number of trees per acre are not predictable. It is this number of trees per acre which determines the carrying cost per tree. Since stand condition isn't safely predictable, any cost figure per tree based on an assumed number of trees per acre is not reasonable.

TABLE # 9.

VALUE OF A SINGLE TREE

****

Year	Value per Tree As It Occurs.		Discount	Discounted Value Per Tree	
	Long Rotation	Short Rotation	Factor	Long Rotation	Short Rotation
1	3¢	3¢	1.04^{1}	2.88¢	2.88¢
2	3¢	3¢	1.04^{2}	2.77¢	2.77¢
3	2.5¢	2.5¢	1.04^{3}	2.12¢	2.12¢
4	2¢	2¢	1.04^{4}	1.71¢	1.71¢
5	2¢	3¢	1.04^{5}	1.64¢	2.47¢
6	2¢	3¢	1.04^{6}	1.58¢	2.37¢
7	Rest	2.5¢	1.04^{7}	0.0	1.90¢
8	Rest	(2¢ (10¢	1.04^{8}	0.0	(1.46¢ (7.3¢
9	3¢		1.04^{9}	2.15¢	
10	3¢		1.04^{10}	2.03¢	
11	2.5¢		1.04^{11}	1.63¢	
12	2¢		1.04^{12}	1.25¢	
13	2¢		1.04^{13}	1.20¢	
14	(2¢ (10¢		1.04^{14}	(1.15¢ (5.78¢	
TOTAL:				27.89¢	24.98¢

This breaks down as follows:

Long rotation; Turpentine income - 22.11¢ - pulpwood, 5.78¢

SHORT " ; Turpentine income - 17.68¢ - pulpwood, 7.3¢

Having convinced myself that any cost figure per tree would be unsatisfactory, I decided to have a fixed cost per tree and let the income vary. The number of trees per acre will be practically the same on either rotation after a time. (Not exactly true as this assumption favors the long rotation over the short rotation). Therefore, the cost per tree, whatever it may be, will be the same and equal for either rotation.

At the end of the first rotation the short rotation (25 years plus 8 years) has released a definite amount of land for further use. It will only require 33 acres to grow and mature a crop where by the long rotation (25 years plus 14 years) 39 ~~years~~ Acres are required. This releases 6 acres out of every 39 acres for further production. Therefore, effective production is increased by 6/39. It follows that production or income per tree must be increased by 6/39 in order for the total production or income to be increased. This increase is made without an increase in cost per acre; therefore, without an increase in cost per tree.

From Table # 9 it is seen that the discounted gross value of a tree on the long rotation is 27.9¢ and that for a tree on the short rotation the discounted gross value per tree is 25¢. Now, this 25¢ per tree may be increased by 6/39 from the reasoning in the preceding paragraph (45/39 x 25¢) or increased to 28.8¢ per tree. This done with out increasing the cost per tree. Therefore, the .9¢ difference between 28.8¢ and 27.9¢ per tree is the net prize and velvet of foresighted management. This increase in effective income per tree in only possible by use of the short rotation.

TABLE # 9-A

Totals of Table # 9 based on an identical cost.

	Long Rotation	Converting Factor.		Short Rotation.
Turpentine	22.11¢	17.68¢ x 45/39	=	20.4¢
Pulpwood	5.78¢	7.3¢ x 45/39	=	8.4¢
TOTALS:	27.89¢			28.8¢

45/39 is the factor by which Short rotation values must be increased in order to put them on the same area basis as the long rotation.

For discussion, see pages 24 & 25 of this paper.

To illustrate the cash value of this, make the safe and conservative assumption of 15 trees maturing on an acre for removal. This would amount to $485 per year net increased income from the short rotation (.9¢ per tree x 15 trees x $\frac{18,000 \text{ acres}}{5 \text{ years}}$)

From Table # 9-A separation of total income based on the preceding same unit of cost shows that the long rotation has a turpentine advantage per tree of 1.7¢ while the short rotation has a pulpwood advantage of 2.6¢ per tree. This gives the short rotation a total income advantage of .9¢ per tree and is based on a higher pulpwood value - attractive to a pulpwood demandind concern.

A pulp company is primarily concerned in securing pulpwood. If it could increase the flow of wood from its own lands without materially reducing the sources of other income, such a move would be considered attractive. This action would partially remove the company from competitive buying in the open market. I repeat, the company could depend on more wood from its own lands and therefore be less dependent on the open market. Therefore, it would be advantageous to get more wood from company land. Reference to Table # 8 will show the discounted income value per acre from the long rotation to be $5.20 and from the short rotation $5.56 per acre. The long rotation income is made up of $3.54 turpentine income and $1.66 pulpwood income. The short rotation shows 12¢ less turpentine income but 48¢ more pulpwood income - a total increase of income of 36¢. Therefore, not only does the short rotation supply more pulpwood but it does so without decreasing ~~the~~ but rather increasing total income.

The short rotation provides for a quicker turnover of goods

on hand (trees), thereby, releasing capital and land for further productive use. This means less inventory on hand at any time or a faster liquidation of inventory.

SUMMARY.

I repeat, decision on the on the use of one or the other rotation rests on the woods policy and turpentine connections of the company conserned. However, there are distinctadvantages to each which I summarize.

SHORT ROTATION:

1). More pulpwood and higher pukpwood income the first 25 years.

2). Higher total income the first 25 years.

3). Lessened dependence on the open or competitive market.

4). A quicker turnover of invested capital.

5). After rotation establishment, A higher pulpwood value and higher total value per tree. (Table #9-A).

LONG ROTATION:

1). A higher turpentine income per tree or per acre.

In favor of the short rotation there is te further thought that turpentine values during the past several years have been on the decline and substitutes are taking their place. It is reasonable to assume that pulpwood is most apt to increase in value in the future. Of course, both of the factors are favorable to the short rotation.