SECTION IV

RATE OF CUTTING

Rate of cutting and its ultimate effects. United States Forest Service statistics (44) for Benton County show that, in 1930, there were 1028 people, or 15.3 per cent of the total population of the county, employed in forestry, saw, and planing mills and other working industries.

Forestry (Woods)	491
Saw and planing mills	514
Furniture and wood working industries	23
Total	1028

The writers found that in February, 1936, there was approximately 675 men employed in logging and milling at those establishments visited. (The authors have been informed that, from February to the present time, April, 3 new mills have started operation.) The fore-going data indicate that, at present, there are over 700 men employed in saw and planing mill work in Benton County, or an increase of over seven per cent in this one phase. It is probable that there has also been an increase in the other two phases of the forest industries, although it is likely not to be so great.

The people directly employed in logging, milling, wood cutting, planing, etc., are not, by any means, the only ones influenced by this industry. Since over 15 per cent of the total population of the county is working in

the forest industries, that per cent likewise exerts a proportionate influence on the other local industries and professions. Whole communities have been established chiefly because of the sawmills and logging activities in that vicinity. Schools and churches have been organized and properties acquired. These properties, as long as the lumber industry thrives, all contribute to the central tax fund.

The survival of the entire county as a unit in itself hinges directly on the two basic industries, agriculture and forestry. Yet, each year the forest land is reduced by an amount equivalent to approximately seven per cent of the total stand, and with no provision for a future timber supply. In a few words, unless rapid cutting and milling are curtailed soon, and if it continues at the same rate as at present, Benton County may be bankrupt within 15 years time.

According to U.S.F.S. statistics there are 3,136,409M board feet of standing timber in Benton County. The mills now in the county are cutting at a rate of 365,000 board feet per day, or, if they were to run steadily 300 days of the year, their total cut in one year's time would equal approximately 200,000,000 board feet per year. At this rate, the county would be completely cut over--this includes hardwoods also--in about 15 years' time.

LEGEND

FOREST STATISTICS FOR BENTON COUNTY, OREGON
FROM INVENTORY PHASE OF FOREST SURVEY

Table I. Volume of Timber by Species for Each Ownership Class in Thousands of Board Feet, Log Scale, Scribner Rule, Data Corrected to January1, 1933

Survey Symbol	Species
DA	Old Growth Douglas Fir, Trees Over 40" DBH
DB	Old Growth Douglas Fir, Trees 20-40" DBH
DC	Second Growth Douglas Fir, Trees 20-40" DBH
DD	Second Growth Douglas Fir, Trees16-20" DBH
HA	Large Western Hemlock, Trees Over 20" DBH
HB	Small Western Hemlock, Trees 16-20" DBH
C	Western Red Cedar, Dead, Trees Over 16" DBH
RC	Western Red Cedar, Dead, Trees Over 16" DBH
WF	White Fir and Lowland White Fir, Trees Over 16" DBH
RA	Red Alder, Trees Over 12" DBH
OC	Oregon White Oak, Trees Over 12" DBH
BC	Black Cottonwood (And Aspen), Trees Over 12" DBH
OM	Bigleaf Maple, Trees Over 12" DBH
ASH	Oregon Ash, Trees Over 12" DBH
	Total

Note--In addition to the species for which sawtimber volume estimates were obtained, Noble Fir, Silver Fir, and Ponderosa Pine are known to occur in inconsequential quantities in this county.

FOREST STATISTICS FOR BENTON COUNTY, OREGON
FROM INVENTORY PHASE OF FOREST SURVEY

Table I. Volume of Timber by Species for Each Ownership
In Thousands of Board Feet, Log Scale, Scribner Rule
Data Corrected to January 1, 1933

Survey Symbol	Private Ownership	PUBLIC OWNERSHIPS			
		State, Available For Cutting	State, Reserved From Cutting	County	Municipal
DA	637,146	3,882	-	7,716	16,319
DB	523,358	1,160	-	3,495	14,912
DC	517,797	8,035	-	10,774	11,425
DD	124,787	1,365	75	1,681	3,080
HA	4,951	55	-	63	162
HB	551	6	-	7	18
C	28,136	13	-	50	307
KC	159	-	-	-	-
WF	87,702	560	-	1,322	1,375
RA	2,816	22	-	30	63
OO	300	-	-	-	-
BC	1,500	-	-	-	-
OM	10,919	122	-	168	359
ASH	200	-	75	-	-
	1,940,315	15,220		25,306	48,020

FOREST STATISTICS FOR BENTON COUNTY, OREGON
FROM INVENTORY PHASE OF FOREST SURVEY

Table I. Volume of Timber by Species for Each Ownership Class in Thousands of Board Feet, Log Scale, Scribner Rule, Data Corrected to January 1, 1933

	PUBLIC OWNERSHIPS			
		Federal		
Survey Symbol	Revested Land Grants O&C Etc.	Other Than Nat. For., Indian And Revested Land Grants	National Forest Available For Cutting	Total For County
DA	353,696	194	105,900	1,124,853
DB	340,955	898	58,990	943,156
DC	117,718	1,618	1,140	668,495
DD	41,370	78	-	172,436
HA	34,795	-	3,073	43,099
HB	3,827	-	-	4,408
C	17,387	8	325	46,216
KC	-	-	-	159
MF	18,421	83	1,827	111,290
RA	1,783	340	240	5,294
OO	-	-	-	300
BC	-	-	-	1,500
OA	3,521	-	-	15,089
ASH	-	-	-	200
	933,467	2,601	171,496	3,136,499

LEGEND

FOREST STATISTICS FOR BENTON COUNTY, OREGON
FROM INVENTORY PHASE OF FOREST SURVEY

Table 2. Area in Acres of all Forest Cover Types, by Ownership Classes Data Corrected to January 1, 1933

Survey Type No.	Definition of Types
2	Nonforest Land other than Agricultural
3	Agricultural: Cultivated, and Cleared Pastures
4	Oak-Madrone: Aforest Containing Over 60% Oaks or Mad. Douglas Fir: A Forest Containing Over 60% Doug. Fir
5	Douglas Fir, Large Old Growth, Over 40" DBH
7	Douglas Fir, Small Old Growth, 20-40" DBH
8	Douglas Fir, Large Second Growth, 20-40" DBH
9	Douglas Fir, Small Second Growth, 6-20" DBH
10	Douglas Fir, Seedlings and Saplings, 0-6" DBH
29	White Fir, Large: A Forest Containing Over 50% White Fir, and Over 20" DBH
31	Hardwoods: Alder, Maple, Ash, and Cottonwood Predom.
35	Old Cutovers, Not Restocked; Clear Cut Prior to 1920
36	Recent Cutovers: Clear Cut Since January 1920
37	Deforested Burns: Any Nonrestocked Burn, Not Cut Over
	Total

FOREST STATISTICS FOR BENTON COUNTY, OREGON
FROM INVENTORY PHASE OF FOREST SURVEY

Teble 2. Area in Acres of All Forest Cover Types, by Ownership Classes Data Corrected to January 1, 1933

Survey Type No.	Private Ownership	PUBLIC OWNERSHIPS			
		State, Available For Cutting	State, Reserved From Cutting	County	Municipal
2	3,080	785	-	50	-
3	185,250	-	-	275	5
4	366	-	-	-	-
6	10,620	100	-	120	200
7	23,075	115	-	365	1,205
8	42,150	635	-	1,480	705
9	33,665	980	80	725	120
10	15,680	210	-	1,485	135
29	480	-	-	-	-
31	1,345	-	-	-	-
35	255	-	-	-	-
36	17,180	580	-	105	60
37	11,610	215	-	565	-
	347,655	3,620	80	5,170	2,430

FOREST STATISTICS FOR BENTON COUNTY, OREGON
FROM INVENTORY PHASE OF FOREST SURVEY

Table 2. Area in Acres of All Forest Cover Types, by Ownership Classes Data Corrected to January 1, 1933

Survey Type No.	Revested Land Grants	Federal Other Than Nat. For., Indian And Revested Land Grants	National Forest Available For Cutting	Total For County
2	120	210	45	4,290
3	256	65	-	188,250
4	-	-	-	365
				20,335
6	8,320	100	1,425	
7	9,370	30	170	34,350
8	6,875	475	280	52,600
9	7,650	2,550	160	45,830
10	3,960	1,290	-	22,760
29				480
	-	-	-	
31	440	110	130	2,025
35	-	-	-	255
36	4,095	-	-	22,080
37	8,045	1,875	30	22,340
	49,130	6,705	2,240	417,030

The decline of forest land in Benton County cannot help resulting in the following:

1. More people out of work and on the rolls of relief.
2. Lowered standards of living because of insufficient tax incomes for maintenance of schools, highways, etc.
3. More tax delinquencies because of the lowered value of land.
4. Higher tax rates on the remaining land.
5. Failure of many of the related industries because of a loss of support from forest workers and industries.
6. An unstable population and transient labor.
7. All possibility of a balanced economic and social structure to which productive forest land and permanent forest industries should contribute may be lost.

Tax delinquency already a problem of great importance. Forest statistics (45) show that, of the total 246,864 acres of county and private land, in Benton County, there were (1930) 86,643 acres, or 35.1 per cent, of tax delinquent land. A large amount of this land has undoubtedly been abandoned after it was stripped of its only value--the forest--and the county must now assume the burden of carrying it. Of course, every piece of property that

goes tax delinquent has the effect of increasing taxes on remaining property, which, in turn, ultimately brings about more tax failures. Already tax burdens on some properties are very heavy. Proof of this can well be demonstrated by the case of mill owner number (38) who offered to sell forty acres of logged-over land to a prospective customer for $40.00. The customer, after saving the required amount of money for purchase of the land, looked up the back taxes on said land to find that they amounted to $42.00, or more than the value of the property.

Regulation is necessary. Conditions such as exist in Benton County today are probably similar throughout the Pacific Northwest, and it appears, from the foregoing data presented that immediate regulation is imperative. In the writers' opinion, however, the need for regulation is probably not as great as is manifested because the high mortality of the small mills will, in a large measure, act as a curtailment to production. Probably, there is a more pressing need for stabilization of the lumber industry; hence populations and other industries than there is for curtailment.

Mills financed by large companies a menace. The small mill owned by the individual is probably not doing as much toward depletion of our timber supplies as those financed by the speculators. Hoffman, U.S.F.S., stated (February 8, 1936) that, at one time, there was 265 small

COUNTY LANDS ACQUIRED BY TAX FORECLOSURE, PRIVATE LANDS DELINQUENT AND NOT DELINQUENT FOR 1930 AND PRIOR TAXES, AS OF JUNE 29, 1932

	acres	per cent
County lands acquired by tax foreclosure	5,226	2.1
1927 and prior taxes delinquent	14,681	5.9
1928 taxes delinquent	5,086	2.1
1929 taxes delinquent	14,408	5.8
1930 taxes delinquent	47,242	19.2
Total county and private delinquent for 1932 and prior taxes	86,643	35.1
Total private not delinquent 1930 and prior	160,221	64.9
Total county and private	246,864	100.0

(From Facts Bearing upon Instability of Forest)

(Land Ownership in Western Oregon--Benton County)

mills in the state of Washington that were financed by one lumber company alone. These mills were mostly electrically driven and capable of producing 10,000 to 12,000 board feet of lumber per day. In most cases, Hoffman stated, a decent wage was not made for anyone connected with the mill except the financier himself. Probably, if these mills were controlled, there would be less overproduction and better lumber prices. These mills undoubtedly contribute much to the hue and cry of overproduction in the lumber industry.

The excess manufacturing capacity of the Pacific coast lumber industry is shown by the West Coast Lumber Association surveys. In 1929, when economic conditions of the country were normal or better, only 73 per cent of the mill capacity was utilized. Plant capacity for the entire country is undoubtedly far more in excess of needs then that shown for the West Coast industry.

Senate Document Number 12 (46) makes the following statement: "Overproduction, also cited as one of the most serious problems of the lumber industry, grows, in part, out of an overload of stumpage and forest land, the consequent financial pressure to liquidate, the development of excessive plant capacity, and the burden of high and largely fixed and inescapable capital costs."

Obstacles to regulation. It is not likely that control measures will ever be brought about by legislation,

because of the constitutional background. There is, however, a possibility of control through the education of the timber owners to forestry practices. This can not be expected to be effective as long as the following conditions exist:

1. Excessive tax burdens on timber owners.
2. As long as there is so much uncertainty of future markets for stumpage.
3. As long as economic conditions are such that timber owners are pressed for immediate cash.
4. As long as the risk in carrying the investment, due to fire, insects, and disease is so high.

Because of the difficulty of coping with the above situations, all control measures must necessarily be slow and time consuming.

Mill to market. Little need be said about this phase of the lumber industry in Benton County. Seven mills are situated directly on the railroad line, and the others haul their products to the shipping point by means of truck. As in hauling from the woods to the mill, the transportation of lumber from the mill to the shipping point is often contracted. The contract price ranges from $1. to $1.50 per thousand board feet.

Because of lack of a tram-way and the heavy precipitation in the winter time, one mill (1) is accessible to a truck for hauling only in the summer. The mill has not been running during the winter months because of this fact. The operators, however, plan beginning continuous operation and hauling all products out during the summer.

The principal outlets for the milling products in Benton County are Blodgett, Kings Valley, Philomath, Greenberry Station, and Corvallis. Probably a larger number of mills ship through Thompson's establishment at Blodgett than from any other point. Mr. Thompson buys in rough, the products of the small mills and stocks the lumber. He planes that for which he has orders and ships the rest rough. In buying material from the small mill, he is able to purchase it as all one grade. If part of the load is of a higher quality, he can thus regrade the material and sell part of it as higher quality products; hence receive a higher price for the lumber sold.

Sale of products. Three mill owners (11, 4, 10) state that they have local markets for part of their manufactured products and a few other owners claim a market for Southern Pacific ties. Aside from this, the entire output of the mills in Benton County is sold through brokers in Eugene, Portland, and other nearby large cities. Brokerage commission ranges from a straight fee of $.50 per 1000 board feet sold, to eight per cent gross receipts. According to authorities from the U.S.F.S. Experiment Station, the fee charged by brokers for the sale of products is only the apparent fee. These authorities state that products are shipped from the small mill owners in large lots. The price paid to the small mill owner for his product is the price of the lowest grades bought in the lot. After its shipment to the broker, the car is unloaded and its contents regraded. Much of the material falls in a grade commanding high prices, and, since this is paid for with the more common grades, the broker gets the "cream," a tidy income that should fall into the hands of the manufacturers. In a few words, the broker is receiving commissions greater than eight per cent or a straight fee of $.50 per 1000 board feet sold.

The small mill owner, with his present set-up, is unable to avoid such losses through sales, because he lacks the connections for sale of his products. J. B. Cuno (13) makes the following statements regarding the sale of pro-

ducts of the small mill owner:

1. The average portable mill owner does not know how to grade the lumber he cuts.
2. He does not know how to stack and season his lumber properly.
3. He does not know how to market his products in competition with the large manufacturers operating in virgin timber.

These statements explain further why the small mill owner is unable to avoid a loss of his profits to sales agencies. Because the small mill is usually under-financed, the owner cannot afford to store stock in the yards or sell in transit.

The place of the small mill. After one has read of many great short-comings of the small mill, its many inefficiencies, and the percentage of failures in the business venture, he wonders whether or not the small mill should have a niche to fill in the lumber industry. Yet it does have a definite and almost indispensible function.

There is no doubt in the author's mind but what the small mill has come to stay, and that the days of the large mill are limited. Most of the more accessable virgin timber has been cut out and cutting is beginning in the second growth stands. This is largely the reason why the small mill predominates in eastern United States. Cutting is now concentrated on isolated more accessable stands of second growth. The large mill, by reason of its heavy equipment and large overhead, cannot profitably log these stands--the writers have stated before that the small mill can often log, mill, and put its products on the market at a price below what the larger mills pay for logs at the pond.

The small mill has, for years, been putting a product on the market that is of lower quality and cheaper grade than that which the large mill will handle. Many of the foreign countries, and the people in this country, except in cases of lumber for special purposes, have been educated to buy and utilize this type of material. Practically all of the material cut in Benton County is in the

form of ties and bridge plank, most of which is shipped to the central part of the United States to be used in the construction of cheap county structures, such as bridges, and form work. The same type of material is used largely also in the larger federal projects such as the Boulder Dam. A market, then, has been built up for this type of product and the small mill is the only one that can supply this demand.

The small mill performs the necessary function of providing part time employment for many who must otherwise, at times, be in jeopardy of starvation. There are approximately 675 men directly employed in logging and milling work in Benton County, and a total of about 2250 people dependent upon part time work in the small sawmills for a livelihood. In this one respect alone, the small mill has a function that is almost indispensible.

The average wage paid the mill workers and loggers in Benton County is approximately $2.95 per day. During times of steady run this would amount to about $2,000.00 per day total, or, on a yearly basis, this equals approximately $600,000.00 in wages paid to residents of Benton County by the small mill owners.

SECTION VII

MILLS OF THE FUTURE

FIGURE 11

One of the more up to date mills in Benton County.

Possibilities for mills of the future. Because the small mill has come to the Pacific Northwest to stay, steps should be made toward its improvement as a more efficient unit of production. These steps will probably eventually move in the direction of one of the three following types of mills:

1. Small electric mill, circular or otherwise.
2. Swedish gang mill.
3. Portable band mill.

A brief summary of current literature on each of the three will be given.

Electric. Because of the nearness to completion of the Bonneville Dam, and the possibility of cheap electrical power, the small electric mill will probably be the first to come to the Pacific Northwest. W. S. Whitney (47) gives the following advantages for the electric mill:

1. Increased production.
2. Decreased shut-down for repairs.
3. Decreased power requirements.
4. Decreased building and foundation costs.
5. More efficient arrangement and grouping of machinery.
6. Centralized power plant.
7. Elimination of shafting and belting.
8. Lowered insurance charges.
9. Decreased payroll.

10. Better quality of manufactured products.

11. Decrease in accidents to employees.

12. Lower cost of oil, waste, and supplies.

13. Adaptability for future expansion.

It is quite likely that the electrification of the small sawmill will initiate a saving in manufacturing costs and increase the margin of profit to the mill owner. This will, undoubtedly, decrease the percentage of small mill failures.

The Scandinavian gang saw. Because of the initial expenditures for its establishment, it will probably never take the place of the small mill as we know it today. Its use in conjunction with the larger band and circular mills, however, would represent a step toward the ideal, from both the mill owner's and forester's viewpoints. Anyone familiar with the logging of virgin stands will realize the unavoidable destruction to small trees. By operating this type of gang saw in conjunction with band mills, it will, in most cases, be possible to log the smaller trees first, cut them on the gang saws, and then cut the larger timber. Since clearcutting, at present, is considered the most feasable of the silvicultural systems to use in the Northwest Douglas Fir, the gang saw should increase the margin of profit in logging, and, by bringing about closer utilization, considerably reduce the fire hazard.

The Scandanavian gang saw will probably represent a large step forward in the practice of intensive silviculture in the Northwest, since its introduction should make possible the utilization of the small stock from management thinnings. Such stock is, at present, considered by most mill owners as being too small for processing on the band or circular mills.

The gang saw has been officially tested in the Pacific Northwest. Axel H. Oxholm (3#) makes the following points in summary of the test made:

1. The gang saw has its principle application in cutting logs 5-20 inches in diameter.
2. It is not replacing the band mill, but rather is utilizing timber they cannot profitably cut.
3. Logs 15 inches at the top diameter and 24 feet in length can be passed through the mill in 90 seconds time. The mill cuts 18 log-feet per second.
4. The mill has a 25-30,000 board feet output per day.
5. Lumber comes out very smooth and unifrom in size.
6. Surfacing on two sides to get specified width is eliminated as uniformity and smoothness are gained in sawing.

7. With the proper planing mill, less than 1/32 inch is taken off the board in planing process (each side) as compared with 1/8 inch wastage in the band sawed lumber.
8. The gang mill gives a 50 to 60 per cent overrun on the scribner scale as compared to the 8-12 per cent overrun with a circular saw. Small logs gave greater overrun.
9. Cheaper costs of manufacturing than by any other method yet devised.
10. An entire gang mill can be established for $15,000.
11. Inexperienced men can soon learn to operate the mill.

The portable band mill. Especially constructed for use in small timber, the portable band sawmill would find its greatest utility in second growth stands such as are typical of Benton County. Like the Scandinavian gang saw, the portable band mill will probably represent a forward step in silviculture by reason of its making possible the utilization of much small logs than can be used in the circular mills or larger band type mills.

The following is a brief resume' of the features of the portable band mill as are given by E. D. Carver (18). The figures given are the specifications for a portable band mill with medium output.

Width of saw blade, about 2½ to 3 inches.

Thickness of saw, about 1/32 of an inch.

Thickness of kerf, 1/16 of an inch (scant).

Saw-teeth are spring set, not swaged.

Weight of mill, about 3 tons.

Width of carriage, 36 to 48 inches.

Horse power to operate, 8 to 20.

Output per day, 1500 to 3000 board feet.

Number of men to operate, 2 to 5.

Maximum diameter of log that can be handled, about 30 inches.

Approximate cost, F.O.B. Factory $700.00 to $1,000.00.

The carriage is moved back and forth with a rack and pinion device operated by hand. Likewise, the knees, dogs, and setworks on the carriage are hand operated. A unique practice is that of edging the lumber on the upward motion side of the band saw. The lumber, while it is being edged, is held in place with a clamp or by hand as the small carriage is pushed back and forth. These mills produce excellently manufactured lumber if properly handled. The realization of lumber from each log is high because of the small loss in sawdust and the close utilization practiced. Compared with the circular and band saws used in the United States, which cut ¼ and 5/32-inch kerfs, the saving from thinner kerf alone would amount to

about 14 per cent and seven per cent respectively.

Although the mill can cut a log as large as 30 inches, it appears that this is seldom done, most of the logs sawed being less than 18 inches in diameter.

A lumber company, with large holdings, has patented a portable band sawmill that is mounted on a flat car built especially for the purpose. The parts of the complete mill, gasoline engine, log loader, log deck, rolls, carriage, saw, and sawdust conveyor, are all on the car and no dismantling is necessary when the mill is moved from place to place. The mill has 2 54-inch wheels and used 18 guage (0.0450 inch) saw, about 6 inches wide. The teeth of which are swaged to a width of 3/32 of an inch. The saw and carriage are fastened to the steel frame of the railway car in proper alignment. Logs are raised to the log deck with an ordinary chain conveyor. The mill contains no edger or trimmer. Each log is turned as it is sawed, which results in some many-edged lumber and some square edged. As the lumber leaves the saw, it is loaded directly on a car for hauling to the kilns for drying. After drying, the lumber is edged, trimmed, and ripped, and is either loaded on a boat for shipment or stored in large covered sheds to await orders.

This mill requires the laying of a light track so that it can be moved easily. As now handled, it is located in the woods and is moved often in order to cut

down logging expense. Five men are required to operate this mill, and the output is from 10 to 12,000 board feet per day.

The designers of this portable band sawmill have in mind mounting in on truck wheels for use where it is not practicable to lay track.

SECTION VIII

SUMMARY AND CONCLUSIONS

Summary and Conclusions. Practically all of the land being cut over in Benton County is denuded without provision for future use. Much of the land is to lie idle or go back to the county for taxes.

Slash disposal on the land is by broadcast burning and much of the land is burned over several times. This may possibly have some effect upon stream polution and the absence of aquatic life.

Even to the most casual observer, inefficiency in many of the logging and milling processes is apparent. At the logging operation, this is most clearly manifested in the distances of yarding logs, the methods of loading logs on trucks or other machines of transportation, and in the minimum size of tree logged. In a few instances, better systems of unloading logs to the mill deck could advantageously be employed.

Almost half of the mills in the county are without log ponds. Sawing logs unwashed not only cuts down output, but also, at times, because of flying rocks and other foreign material from the headsaw, brings about an accident hazard to the workmen. In mills where log rollways are employed for log storage there is an occasional shut-down because of broken logging equipment or bad weather. Mills with greater space for storage could, in a measure, avert such a shut-down. For this reason, the use of a log pond is very advantageous.

In all but one case, log lifts are of the cable drag type. The skidway from the pond to the mill deck should be properly reinforced to avoid a possible tie-up in production. A cheap and efficient reinforcement method consisting of railroad irons laid side by side parallel to the length of the slide has been used in one mill.

Logs are, in most instances, turned on the carriage by hand. In many cases, this is accompanied by much lost motion and loss of time.

Some mills typify a lack of efficiency in that they have been poorly built as regards ample room for effective use of the mill machinery. Such construction in three mills is a high potential accident hazard.

The double circular saw predominates in Benton County, and it also serves as an edger saw. Such use of the headsaw cuts the output of the mill in half and causes excessive waste in slabs and edgings, inaccuracy in widths, and waney boards. This, no doubt, increases output costs per 1000 board feet considerably.

Less than one third of the Benton County mills have a market for by-products, such as slabwood and sawdust. Such waste is usually deposited in some near-by creek and burned. This may possibly have some effect upon aquatic life in some of the Benton County streams.

In one fourth of the mills in Benton County, power is inadequate for the proper functioning of the sawmill

machinery. This has the effects of decreasing output per day and increasing the cost per 1000 board feet of all material sawed.

Over 50 per cent of the mill owners in Benton County do not keep adequate cost records or realize the necessity for such a practice. They are, in a way, paving the way to financial disaster because of this.

The average mill owner is not well versed in the science of air drying lumber in the yards. He does not realize the necessity for sanitation and proper air circulation. In most instances in Benton County, storage yards are not satisfactory from any point of view.

At least three fourths of the mill owners in the county work at some important job at the mill and leave the other phases of logging and milling without the proper supervision. This may, in some respects, account for the great amount of inefficiency shown throughout the milling and logging operations. Most mill owners have not had the proper training along the lines of the business which they seek to follow.

The term "marginal log" is a term of mystery to the average small mill owner. Any log large enough to make lumber of any size or type is considered as merchantable by the majority of mill owners. The minimum log cut in the county averages below twelve inches in diameter and is probably four or five inches smaller than the marginal

log. The small timber produces narrower widths, and the cheaper grades of lumber which are also the most costly to produce.

In dealing with small logs, it is important to remember the following points:

1. Man capacity is twice as high with 20-inch logs as with 8-inch.
2. It takes three times as long to skid 1000 feet of 8-inch diameter logs as the same amount in 20-inch logs.
3. It requires four times as long to load a car with 1000 feet of 10-inch logs as to load 1000 feet of 20-inch logs.
4. A car will haul three times as much in volume of 20-inch logs as it will of logs 10 inches in diameter.
5. It requires twice as long to saw 1000 feet of lumber from logs with an 8-inch diameter as from logs which average 20 inches in diameter.

No studies of marginal logs have been made by any mill owners in Benton County.

The larger majority of the small mills that start up are not a success. This failure can usually be traced to inefficiency, under-financed conditions, and the reluctancy of the mill owner to know the limitations of his

plant.

The small mill owners have, in some communities, been given the name of "come by day and fly by nighters" because of the unscrupulous business dealings of a few individuals. In some instances, mill help resides under conditions that are most squalid.

If all of the mills in Benton County survive, and cutting continues at its present rate, the county will be denuded of timber land in less than fifteen years.

Over 15 per cent of the population of Benton County is employed in forestry.

The survival of the communities in some places is largely dependent upon the survival of the forest industries.

Forest industries are on the rapid decline in Benton County, and this decline will ultimately lead to the following:

1. More unemployment.
2. Lowered standards of living.
3. More tax delinquencies.
4. Greater tax burdens on remaining industries.
5. Failure of related industries.
6. Unstable populations.
7. Loss of a possibility of a balanced economic and social structure.

Tax delinquency, even at present, is a great problem

in Benton County. Thirty-five per cent of the county and privately owned lands are now tax delinquent.

Regulation is necessary but probably not as imperative as stabilization of industry and communities. Mortality in the small mills will curtail production. The small mills financed by speculators are doing much to bring about overproduction.

Factors effecting overproduction are overload of stumpage and forest land, financial pressure to liquidate, excessive plant capacity, and high costs of operation.

Regulation is hampered by excessive tax burdens, uncertain future stumpage prices, high risk, and the need for immediate cash.

Practically all of the sawed products from Benton County are disposed of through brokers. In many instances, the brokers reap a commission much greater than is manifested by their commission fee. The small mill owner is unable to avoid these losses because of his lack of knowledge in grading products and his limited finances which prohibit his storing lumber or selling in transit.

The small sawmill, with all of its short-comings, has a definite niche to fill in the lumber industry. It is almost an indispensable unit of business for the following reasons:

1. It can profitably log and mill bodies of tim-

ber that are too small for the large mill.

2. It must supply a demand that has been built up for a poorer grade of material.

3. It furnishes part time employment for many who would otherwise be in jeopardy of starvation.

The small mill has, undoubtedly, come to the Pacific Northwest to stay, and the more efficient units of production of the future will probably be of three types: The electrically driven mill, the Scandinavian gang type--to be used in conjunction with the larger mills--and the portable band mill. The latter two have their greatest utility in their being able to manufacture profitably the smaller diameter logs.

SECTION IX

RECOMMENDATIONS

Recommendations. In a review of the subject matter of the thesis thus far presented, two facts of outstanding importance manifest themselves:

1. That there is a great need for efficiency in mill operation.
2. That, unless curtailment of some type is applied soon to logging milling, Benton County must prepare to suffer the loss of her entire forest enterprise.

A short course for loggers and mill owners. In most state agricultural schools, short courses are given annually to those agriculturists, dairy men, and poultry men who wish to attend. These short courses are usually of only a few days' duration and generally are free of charge. In the authors' mind, such a course as this should be given for the mill owners and loggers of the state who wish to attend. It is quite apparent that inefficiency is a large factor contributing to the high mortality of small mills. This inefficiency rises, not from an unwillingness to do better, but because the average mill owner has not had the training to see the inefficiency of his ways. At the time many of the mill owners began earning their livings by doing odd jobs around the mills or logging operations, a marginal log was almost an unheard of thing. These men have grown up with small mills and "gypo" outfits, in an atmosphere to

which these later developments have not been introduced. Thus, many of them have remained in ignorance of some of the newer developments in milling and logging. True enough, literature has been available on these subjects, but the average layman does not know the value of such literature or where it is available if he does. As before stated, the education of the average small mill owner in Benton County is little more than that of grammar school instruction. For this reason, a large part of scientific literature may be of such a nature that he will not readily understand it.

Most mill owners welcomed the authors to inspect their establishment and even took time out from work they were doing to answer questions. Many have stated that students were welcome to visit their mills at any time and that they were always open for suggestions for improvement. The average small mill owner realized his limited knowledge of his own business. Several have stated that they felt that only a small profit, if any, was realized from their small logs, and they had no way of knowing. Others have asked the writers to make log studies on their operations.

The authors feel that should a short course at Oregon State College be given for loggers and lumbermen, the attendence would be high. Short courses are given in state colleges for horticulturists, poultry men, dairy

men, and agriculturists, and it seems only logical that such action should be initiated for the lumber industry, one of the most important of the Pacific Northwest.

The course should consist of both lectures and practical demonstrations along the lines of sawing, mill construction and operation, lumber grading and seasoning, marginal log determination, and various phases of the logging industry. Small inefficiencies that may arise in logging and milling should be pointed out and the more improved methods brought to light. If such a course should be initiated it might go far toward cutting the high mill mortality and loss of payroll. It would undoubtedly lead to higher quality products, and more stabilized communities.

Individual student projects in logging and milling. For a second recommendation, the authors should like to suggest that practical problems of the mill man and logger of the vicinity about Corvallis, Oregon, be worked out by the forestry students of the college in connection with their undergraduate work. Practical problems attacked by students at present are chiefly along the lines of silviculture. These studies are invaluable in themselves but a more diversified universe would give the student greater insight into the forestry situation as a whole.

Studies could well be conducted along the lines of

marginal log determinations for mills of different capacities and in a variety of conditions, for example, a certain type of topography, variation in average D.B.H. of stands, and methods of logging. In a few years' time, with such information as could be collected from these studies, the school of forestry could, with a knowledge of the timber stand and topography of a given area, predict, with a fair degree of accuracy, the size of operation that should log that area, the method of logging to use, and the probably marginal tree to leave in the woods. Such measures as these could possibly spell the difference between profit and loss; hence the survival of the small mill.

Cooperation is needed in the small mills. In the opinion of the writers there is a crying need for cooperation among small mill owners. The old adage "two heads are better than one" could well be put to use by these men. Undoubtedly, they could be of great assistance to each other in solving small problems that arise daily in logging and milling.

A more intensive form of cooperation could take the form of a community dry kiln or cooperative sales agency. The kiln, for example, could be located at the community shipping point. Many of the mill owners object to such a setup, because they feel that the services of an expert are required for operating the kiln. In the opinion of

the writers, the ordinary conscientious layman can learn to operate a kiln if he abides by his handbook and studies it carefully.

Ordinarily the small mill owner does not own his planer, and, if he has planing done, such as is the case of several mills in Benton County, it is at a central dock, usually located at the shipping point. Material taken to the landing could be dried, graded, and planed. Even if products were sold through brokers after that, the practice of "skimming the cream" as is the policy of some of the brokerage agencies, could be, in a large measure, eliminated. Drying and planing, as it did with the products of mill number 10, would undoubtedly yield a more uniform grade of material and such as would find a better market than is found by the average small mill product.

That a central sales agency is practical has been well demonstrated by Thompson's establishment at Blodgett. All of the small mills of the vicinity of Blodgett ship their products through him. Mr. Thompson has developed his own trade. He planes a large portion of his lumber, and, because of the quality products he handles, finds a ready market for all material he has for sale.

It would be a great benefit to the small mill owners if they could, in some way organize and establish a central sales agency of their own. Such organization and market establishment would require considerable time and

and much study, and the change of marketing through their own agency rather than through brokers would necessarily be as gradual as the upbuilding of markets for their products, but it is not at all impossible. If a central sales organization could be organized in conjunction with a community kiln and planer, it is quite possible that the combination could spell dollars in the pocket of the small mill owner each month; hence decrease the mortality in the small mills.

Regulation of timber cut in Benton County is needed. That there is a need for regulation of the timber cut in Benton County is very obvious. It is quite likely that even if the county were covered with a full stocking of fir on all of its lands suited to timber growing, there would be an inadequate supply for the continued operation of all of the small mills now running.

If, by legislation, it would be possible to control the number of mills, and, if, by a system of permits based upon the fitness of the milling aspirant, the government could state who was to log and mill a given area, the problem of cutting control would be easily solved. It is not likely, however, that such legislation will be had, for it is a restraint of free trade; hence an encroachment upon constitutional rights.

Probably the only feaseble means of maintaing a sustained timber supply in Benton County is through the pri-

vate owner, and this will never be possible as long as the individual has no inducement for raising timber and is pressed for cash. It is expecting too much of the private timber holder, even if he is well-educated to forestry practices, to think that he will maintain his timberland while losing money on it. Therefore an inducement of some type must be offered. The forest taxation inquiry offers a deferred timber tax as being the most feasable remedy for the taxation problem. The principal points of this plan are as follows:

1. Land value--taxed under ordinary property tax.
2. Timber value--tax deferred until income is received. Taxes accumulate without interest as a charge against the property.
3. Any income received is used to pay the accumulated taxes--the payment is limited to an amount equal to a specified percentage of the gross timber income. This portion of the timber estimate should be specified by law and be large enough to cover the accumulated taxes under the most unfavorable conditions of income deferment. It will probably be 30 per cent or 40 per cent of the gross timber income.
4. The state assumes the burden of financing tax

payments. It receives money from timber owners when they receive incomes from timber.

The deferred timber tax system, however, is not a remedy for the land owner who needs cash badly at a time before his timber is mature. He will sell at the first offer rather than be in jeopardy of starvation. The probable solution, then, lies only in a lowering of governmental costs, and betterment of general economic conditions combined with a system of education and the revegetation of denuded lands. The writers feel that delving into the first three parts of the solution is beyond the universe of their thesis and for minds of greater depth than theirs. Revegetation of denuded lands is treated elsewhere in this thesis.

INTRODUCTION

Geologists have gathered information to prove, and Foresters have found written in the trunks of the standing trees, that the forests of the Willamette Valley are a most recent addition to the cover of this vast expanse of fertile soil. The story of the rocks in the history of the world, is, that a short time ago the ocean extended inland for miles from where the shores now lie. Shells of the molusks common to the coastal waters have been found in various places in the Willamette drainage. The Pacific Northwest is "New Country" in a geologic sense. The soil has had but a short time in which to build fertility and to cover its surface with vegetation of the higher types. The Indians, too, with their practice of yearly burning for various reasons, held back this march of vegetation. So it is that the "Second Growth" of this valley has come, within the last century or less.

When the white man came to the vicinity of Corvallis there were few trees of any sort. Along the streams in the moist locations, willows, cottonwood and the companion species were to be found in narrow strips and small isolated stands; farther up on the slopes of the foothills white oak in scattered numbers was trying to gain a foothold. Standing alone in gnarled strength, on hilltops, in protected locations on the slopes below, or safe beside

some cool protecting stream, the first of the invaders from the Douglas fir forest fought to hold their ground. Back toward the backbone of the Coast Range and across the valley in the lower reaches of the Cascades, the Douglas fir in all its grandeur held away.

Since the coming of the white man with his laws against unchecked burning, and with his respect for the trees that furnish fuel and lumber, the progeny of the few isolated old fir, in this area, have crept down the hillsides to cover the slopes with a mantle of green.

Where allowed to continue their slow progress these trees are spreading out into fields and even taking abandoned homesteads and bottom lands. Stands of fir ten to thirty inches in diameter are now standing on areas gained in the last sixty to eighty years. In some localities this spread has been more gradual than in others. The soil, elevation, physiography and many other factors have entered into the life patterns of the various stands.

When man came he brought with him cattle, goats and sheep. He pastured these animals on the land where Douglas fir grew. Later he fought the fir as it encroached on his pastures. Steep hillsides are even yet slashed off and burned to make pasture for grazing animals. Denudation of the hillsides usually results in erosion of some intensity. Later the trees became large enough for

use and man began cutting them in wholesale quantities. [109] His methods of cutting have on the whole, been very destructive to the stands of timber, and slash disposal as practiced has resulted in a multitude of problems pertinent to the re-establishment of a productive forest. With the cutting out of the eastern and southern mature stands of timber, we are feeling the effect of a growing lumber market. As a result, man is wondering what is wrong with his methods and hoping to evolve a silvicultural system which will allow the fullest utilization of the forest land. It is because of this train of events that the authors have embarked upon the study of the Douglas fir.

Problem: The purpose of this phase of the thesis is to present the factors affecting Douglas fir reproduction in as complete form as possible and from this presentation to draw conclusions which will contribute to the knowledge of the subject so as to allow for a better system of management, silviculturally, than is now in practice.

Previous to this time, many authors have touched on various portions of the problem of Douglas fir reproduction. The Forest Service has compiled data down thru the years and several prominent officials have contributed to the literature on the subject. Usually, however, the investigators are concerned with only one angle of our

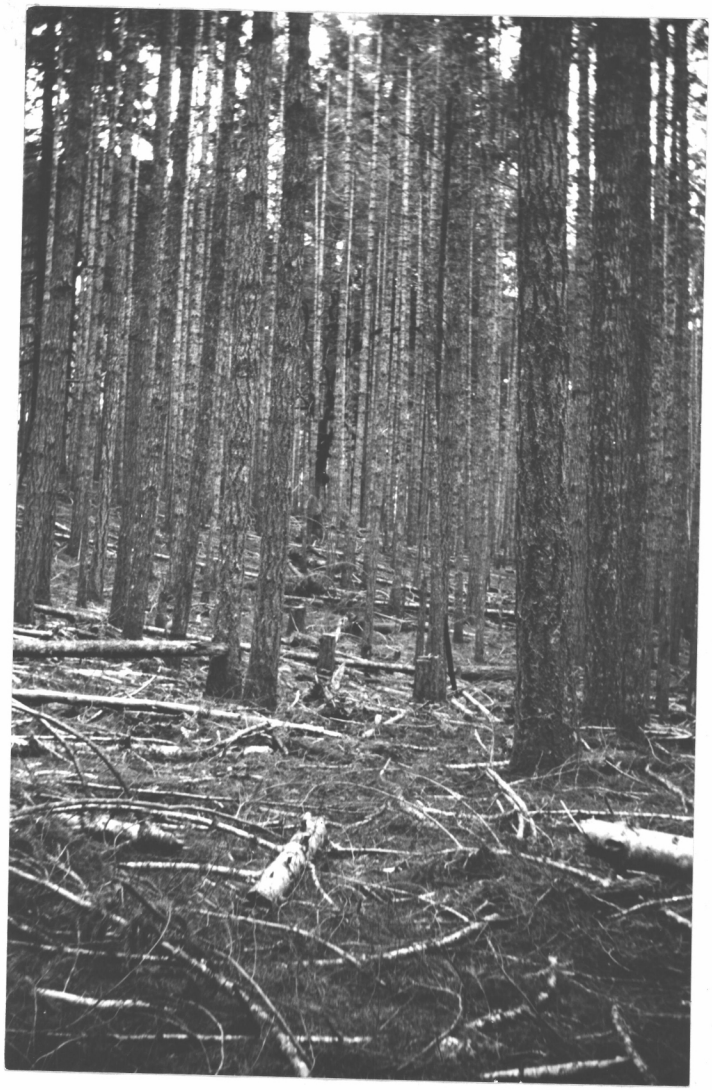
study. T. T. Munger, Leo Isaac, J. V. Hofmann and many other foresters have published papers on Douglas fir in the past. We acknowledge the wealth of information furnished by those authorities and are glad to utilize it in our work. At the Oregon State College several students have been interested in the subject and they also have compiled information valuable to the study. Harry Howells and Henry Tiedemann especially, are outstanding in their contributions.

Because of limitations in time, money, and field of study, we have not completed the work as we would have liked. More sample plots, transects thru a wider variety of sample areas, an enlarged field of study, more complete and detailed methods of study would all have helped to mature our judgment and build our framework of material, however, limited as we have been, we offer our work realizing its inadequacy and hoping that there is some essence of truth in our conclusions.

We studied each logging and milling operation in Benton county. We ran our lines through some of the areas and took sample plots at regular intervals. Discussion of the factors with men in the field and office was welcomed and sought after. Finally with this background we set to work on the literature available on the problem and on literature pertinent to the problem though not exactly coincident with it. This literature was briefed

and compiled in a reference volume. After this labor was completed we started on our own interpretation of the factors concerned. By analysis of data accumulated and frequent reference to our brief with discussions of viewpoints, methods and conclusions, we finally worked out our dissertation.

FIGURE 12



A residual stand of young Douglas fir.

This operation has opened the crowns sufficiently to induce growth but not enough to injure the stand in any way. (Logged under direction of Prof. T. J. Starker of the Forest School)

See also Figure 13

FIGURE 13

Selective logging done under guidance of Prof. T. J. Starker.

SILVICULTURAL STUDIES

Benton county presents a situation which is rather severe on the student making studies of a silvicultural nature. The mills for the last few years have been doing very little, but at the present time they are expanding very rapidly. The result is that there are numerous small logged areas, but very few areas large enough to furnish adequate sampling. Another factor that adds to the difficulty is that the mills move at short intervals of time, and it is hard to find where they have been, and so get the history of each area.

With the foregoing in mind we decided to study what areas we could by means of the sample plot method, and to supplement these studies by observations at the different mill sites. This method has given a background with which we endeavored to properly interpret the work that has been done in this field previously. Silvicultural plots, to be of the greatest value, should be so located that frequent studies over a long period of years may be made. In this way, data can be accumulated which are precise and accurate. Not having the time or opportunity to do this, we are forced to supplement observations in the field by study of the more intensive work that has been done by other students and silviculturists.

The following series are sample areas selected because the history of each one is known, allowing for a better interpretation of the present vegetation.

Miller Series.

On this station we have an area heavily grazed by sheep. It lies in a protected little valley and is abundantly supplied by seed trees. A burn went thru the cutting in 1932, and since that time it has been free from fire.

We ran a line across the drainage, taking sample plots, 6.6 feet in area, every five chains.

Although our studies at this location are insufficient to draw conclusions of any great weight, they do seem to point to the fact that sheep are very harmful to reproduction when in great excess. They also point out the fact that to adequately reseed the area an abundance of seed trees is necessary.

SECTION X

PRESENTATION OF DATA

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1.Aspect 2.Slope	Vegeta-tiveDes-cription	Repro-duction	Grazing	Soil Description	Seed Trees
1	1. E 2.5%	B Fern Weeds Grass W Iris	2 D F	Heavily grazed (sheep)	Burned clay	1 chain
2	1.N E 2.10%	Hazel B Fern S " Weeds Grass	5 D F	Protect-ed by brush	No duff " humus clay	1 "
3	1.S E 2.10%	B Fern Grass Weeds	6 D F	Lightly grazed	No duff " humus clay	1 "
4	1.S E 2.10%	B Fern Salal Grass Weeds	8 B F	Lightly grazed	No duff " humus clay char-coal	1 "
5	1.S,E 2.10%	B Fern Weeds Grass	1 D F	Lightly grazed	No duff " humus clay	1 "
6	1.S E 2. 5%	B Fern Grass	None	Heavily grazed	char-coal No duff " humus clay	1 "
7	1.S E 2. 2%	B Fern Grass W Iris WStraw-berry	1 D F	Heavily grazed	char-coal No duff " humus clay	1 "

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1.Aspect 2.Slope	Vegeta- tive De- scription	Repro- duction	Grazing	Soil Descrip- tion	Seed Trees
8	1.S E 2.10%	B Fern Bberry Weeds Grass	None	Heavily grazed	Charcoal No duff " humus clay	1 chain
9	1.S E 2. 10%	B Fern Bberry Grass	None	Heavily grazed	Charcoal No duff " humus clay	1 "
10	1.S E 2. 5%	B Fern Weeds Grass	None	On trail Heavily grazed	No duff " humus clay	1 "
11	1. S E 2. 10%	B Fern Salal Grass Weeds	6 D F	Protect- ed by trash	No duff " humus clay	1 "
12	1.S 2. 10%	B Fern Salal Grass Weeds	8 D F	Protect- ed by trash some grazing	No duff " humus clay	1 "
13	1. N 2. 15%	Salal Grass Weeds	6 D F	Protect- ed by trash Some grazing	No duff " humus clay	1 "
14	1. N E 2.20%	B Fern Grass Weeds	None	Lightly grazed	No duff " hu us clay	1 "

DATA SHEET FOR BENTON COUNTY MILLS
SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegeta-tive Des-cription	Repro-duction	Grazing	Soil Descrip-tion	Seed Trees
15	1. N E 2. 10%	Weeds Grass	None	Heavily grazed	No duff " humus clay	1 chain
16	1. S 2.10%	B Fern Grass	None	Heavily grazed	No duff " humus clay	1 "

Hawley Series

Slash disposal at the station here described is limited to "touching it off." The result is a partially burned area literally covered with logs and charred debris. One fire was set off in the fall of 1933, another in the fall of 1934, and the last one in the fall of 1935. These fires in all cases overlapped the preceding fire to as much as fifty per cent. Burning back over the previous years burn, they destroyed any reproduction established in the meantime, and killed a few more seed trees left in the original logging. The fires in time insure the area of a long hard fight back to productivity.

In laying out our plots, we selected an area burned over in the fall of 1933. We had to change the course of our study twice to avoid the reburns for we felt, that to get a representative sampling of the 1933 fire area, we would have to do this.

The plots were taken every 2½ chains and were 6.6 feet square.

The area was for the most part heavily grazed and the seedlings in many places showed signs of having been cropped by the cattle. Seed trees are more than ample and the site has moisture in sufficiency, being on a hillside fed by numerous seepages. The way the seedlings on this small portion of the area are

fighting to come back shows that with proper protection the area would quickly be covered with another stand of Douglas fir.

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
1	1. N 2. 1%	Grass Weeds Thistles	2 D F (1-cropped)	Heavily grazed (cows)	No duff " humus gravelly clay	4 chains
2	1. N 2. 5%	Grass Sedge B Fern Weeds	1 D F	Heavily grazed	No duff " humus clay	4 "
3	1. N 2. 10%	B Fern Thistles Grass	None	Heavily grazed	No duff " humus clay	2 "
4	1. N 2. 15%	B Fern [illegible]berry BE " [illegible]cherry Thistles Grass	None	Heavily grazed	No duff " humus gravelly clay	3 "
5	1. N 2. 10%	B Fern [illegible]Berry [illegible]cherry Thistles	None	Heavily grazed	No duff " humus clay	4 "
6	1. N 2. 10%	B Fern [illegible]Berry [illegible]cherry Thistles	None	Heavily grazed	No duff " humus	5 "
7	1. N 2. 20%	Alder Thistles Grass Moss	None	Heavily grazed	No duff " humus Burned& Decaying logs	4 "

DATA SHEET FOR BENTON COUNTY MILLS
SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Descrip-	Reproduction	Grazing	Soil Description	Seed Trees
8	1. N 2. 30%	Thorny Alder Moss	5 D F	Protected by logs etc.	Mass of decaying	2 chains
9	1. N 2. 20%	Hawthorn Thistles Grass Moss	None	Heavily grazed	No duff " humus clay	3 "
10	1. N 2. 30%	B Fern S " Thorny	1 D F (cropped)	Lightly grazed	No duff " humus gravelly clay	5 "
11	1. N 2. 40%	Vmaple Thorny Fireweed grass Moss	1 D F	Lightly grazed	No duff " humus clay	4 "
12	1. N 2.40%	B Fern Thorny Thistles Grass Moss	None	Heavily grazed	No duff " humus clay	2 "
13	1. N 2.50%	B Fern Thorny Grass Moss Fireweed	"	Lightly grazed	Charcoal No duff " humus	5 "
14	1. N 2. 30%	B Fern Thorny Thistles Moss VMaple Fireweed	11 D F	Protected by logs	No duff " humus	5 "

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Descrip-	Reproduction	Grazing	Soil Descrip-tion	Seed Trees
15	1. N 2 10%	Dense thicket Maple Cherry Fern Firewood Cherry	None	None	No duff " humus clay	3 chains

Burge Series

These plots were taken in an area cut-over in 1931 for cordwood. The land lies on the bank of a small stream. It is fairly well shaded by the trees left after cutting and the ground was cut up by the operation. Since there are only a few acres in the tract the data are not very conclusive but they were taken because there are so few places in the county where one can find Douglas fir land which has not been burned over and which has not been grazed. The plots were taken 1 chain apart and were six feet six inches square. The land has not been burned for at least sixty years, whether because of protection or not, and the ground is in fine shape.

The area has a slight slope to the south and east and the moisture probably is sufficient, even for seedlings, the year round. The result has been satisfactory in seedling survival and in the course of a few years a new stand should be closed over the soil. The seedlings now on the plot have come in since 1931 and are there in sufficient numbers to adequately stock the area even without further stocking. That is assuming, of course, that grazing is not allowed in the near future and that fire will not enter.

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
1	1. S E 2. 2%	Hazel OSpray Grass Weeds	None	None	Clay loam Some humus	1 chain
2	1. S E 2. 3%	Hazel S Fern Bberry Grass Weeds	3 D F 2" - 6"	None	Clay loam	½ "
3	1. S E 2. 0%	Bberry Hazel Grass Weeds	10-F 6"	None	Clay loam	½ "
4	1. S E 2. 5%	Hazel Bberry Grass Weeds	None	None	Clay loam	2 "
5	1. S E 2. 5%	Bberry OSpray OGrape Grass	None	None	Clay loam	1 "

Alsea Series

The timber logged from this area was taken chiefly from the watersheds of Yew and Alder creeks on the headwaters of the Alsea river. The topography on the land is rough, ranging usually around 30 to 50 per cent. This ground has been burned over by fire upon two different occasions. It is covered by litter in only a few places and as yet the weeds, brush etc., do not cover it to such an extent as to keep the soil from eroding. The first large fire swept through this area in 1927; the second one added to the desolation with a reburn in 1932. From data collected by Rasmussen at Corvallis, it may readily be seen that tons of earth from this burn must have been swept into the creeks by the heavy rains. The appearance of the ground bears out this conclusion.

The timber cut consisted of Douglas fir, hemlock and cedar, and was taken off of the area by the high-lead method. The evidence of the logging method can be seen in places of continued erosion.

The remaining live seed trees are very few. They are not nearly adequate for the restocking of the area. As a result, it lies slowly recuperating from the effect of the burns. The vegetation now on the area is of no value to man but it may be of value in rebuilding the

soil. The only way for a new stand to become established in the next one hundred years will be by the efforts of man.

1/1000 acre plots were taken every five chains over this burn.

The line of progress was across the canyons so as to give as characteristic a sampling as possible of the entire area.

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot	1. Aspect 2. Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
1	1. S E 2. 30%	B Fern Salal TBerry Hazel	None	None	About 1" of litter No humus Olympic clay	5 chains
2	1. S E 2. 50%	B Fern Salal WBberry	None	None	"	4 "
3	1. N 2. 5%	Tberry Fireweed WBberry BElder-berry	4 D F 4"-8"	None	No litter No humus Olympic clay	1 "
4	1. N 2. 30%	Fireweed TBerry WBberry BElder" Woberry Violet	None	None	"	6 "
5	1. N 2. 20%	B Fern TBerry S Sorrel WBberry Moss	1 D F 5"	None	Some litter Olympic clay	4 "
6	1. N 2. 30%	Tberry Fireweed S Sorrel Moss	None	None	½" litter Olympic Clay	6 "
7	1. S E 2. 10%	B Fern WBberry Tberry	None	None	1" litter Olympic clay	8 "

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
8	1. S 2. 30%	B Fern Fireweed Blberry RyeGrass	None	None	No duff " humus	9 chains
9	1. N E 2. 20%	Blberry Fireweed	"	"	No duff "humus Much charcoal	12 "
10	1. S E 2. 40%	B Fern Blberry Fireweed Blackcap Tberry	"	"	Very little litter No humus	4 " Thuja p
11	1. N 2. 30%	Blberry T berry Fireweed	"	"	½"litter No humus	8chains
12	1. N E 2. 20%	S Fern SolomanS Tberry SSorrel	"	"	No litter No humus Much charcoal	6 "
13	1. N E 2. 20%	B Fern S " Tberry BElder berry	"	"	Some litter No humus	7 "
14	1. N E 2. 20%	VMaple Tberry SSorrel SFern	"	"	½" litter No humus	8 "

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope %	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
15	1. N 2. 10%	S Fern Fireweed Moss	None	None	No duff " humus	2 chains
16	1. N E 2. 20%	S Fern Salal Chinquapin Cherry	S D F 6"	"	No duff " humus	1 "
17	1. N E 2. 0%	Dense pole stand	Poles 6x6 av. 3"-6" diameter	"	½" duff No humus	3 "

Kings Valley Series

These plots were taken in an area logged over in 1914. The land has been grased some, but very lightly. It is fenced and consists of two ridges with a dry gully between. There are quite a few seed trees of Douglas fir and of white fir scattered over the area so the seed source is comparatively ample. This 80 acres is the only logged ground in this particular valley, that had any extensive reproduction on it. The rest of the land (section after section) is seeded to grass and is being held in this sub-climax stage by fire and grazing of sheep and cattle.

This 80 acres studied was logged by horses. Being of a rather loose gravelly structure, the soil is likely to be deficient in moisture. Had it been logged carefully with an idea to protecting the soil from deterioration, it no doubt would have had a new stand, either of Douglas fir or white fir, by this time. As it was, the soil was opened up to the destructive action of the elements. The result was a rapid decomposition of humus and a lowering of the moisture-holding capacity. The brush covering of the area came in as the next step in the succession. As soon as the soil is built up to a sufficient strength and moisture- holding capacity, the next stage will move in as already shown in the reproduc-

tion found in the plots.

This area is in section 26, T. 10 S., R. 7 W., being a short distance down the valley from the larger mill owned by Christensen Brothers.

The plots were taken every 2½ chains. The line of advance was taken so as to offer as nearly a representative sampling as possible. These plots are six feet six inches square.

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
1	1. N E 2. 50%	OGrape VBberry S rose S Forb Grass Weeds	2 W fir 10 yrs old 1'-3"	Very little	Bare Mineral Soil	1 chain
2	1. N E 2.30%	OGrape VBberry Vrose	None	None	Dense mat of maple leaves rocky	10 "
3	1. S E 2.30%	OSpray Hasel Rose	"	"	Decomposed limbs, etc. rocky	10 "
4	1. S E 2. 30%	Some Salal Rose	"	"	fell on decomposed log	6 "
5	1. E 2. 20%	Salal Rose OSpray	"	"	Rocky Little litter	4 "
6	1. E 2. 10%	VMaple Moss Rose T berry Salal OG OSpray	3 D F 4"-3' 1-10 yrs old	"	Rocky Some humus	2 "
7	1. N E 2.10%	VMaple T berry OGrape Moss OSpray	None	"	Some humus	1 "

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
8	1. N E 2. 10%	VMaple Berry OGrape Moss	None	None	Some humus	1 chain
9	1. N E 2. 30%	VMaple T berry OGrape Moss	"	"	Rocky soil Some humus	2 "
10	1. N 2. 30%	T berry OGrape S Fern	S D F 1"-6'	Rabbit damage	Gravelly Some litter	1 "
11	1. N 2. 30%	B Fern T berry Salal OSpray	4 D F 1-7 yrs 1"-4'	None	Humus Maple leaves gravelly	1 "
12	1. E 2. 20%	B Fern Weeds Moss Shade 25%	S D F 2"-6' 1-10 yrs	"	Dead limbs rocky Some humus	Less than 1 chain
13	1. E 2. 10%	T berry B Fern	None	"	Dense mat Maple leaves	1 "
14	1. W 2. 30%	Rose T berry Moss	2 D F 1"-10'	"	gravelly soil	1 chain

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1.Aspect 2.Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
15	1. N W 2. 40%	T berry O Spray Rose Moss	S D F 2"-3'	None	Some humus	4 chains
16	1. N W 2. 30%	T berry O Spray Rose S Fern Moss	None	"	Plot fell on pile of decomposing brush	2 "
17	1. N W 2. 30%	Rose S Fern	1 D F 6"	"	Rotted limbs Maple leaves Some humus	4 "
18	1.N W 2. 10%	FCurrant T berry Salal Grass	S D F 3" - 6'	None	Leaf litter Some humus	3 "
19	1. N W 2. 10%	B Fern Salal T berry Wberry O Grape Moss	None	"	Dense mat of decomposing brush	5 "
20	1. N W 2. 10%	S Fern B " T berry Salal O Spray F Currant	"	"	Some humus	6 chains
21	1. N 2. 20%	O Grape B Fern S " O Spray	S D F 2" -6'	"	Gravelly porous soil	3 "

DATA SHEET FOR BENTON COUNTY MILLS

SILVICULTURAL STUDIES

Plot No.	1. Aspect 2. Slope	Vegetative Description	Reproduction	Grazing	Soil Description	Seed Trees
22	1. N 2. 10%	Salal S Fern Rose	3 D F	Some	Some humus	6 chains
23	1. N 2. 10%	Rose B Fern FCurrant O Grape Grass Moss	1 D F	Some	Some humus Grass sod gravel below	6 "

FIGURE 14

Desolation - a case for skeletal planting.

SECTION XI

THE EDAPHIC FACTORS

Soil. In Benton county, the forest soils are of residual origin and are derived from igneous or sedimentary rocks. Bedrock is encountered at depths of 6 to 36 inches, and detached rock fragments or boulders are numerous on the surface. Rock outcrops are common along the breaks and steeper mountain sides. Small areas in the developed agricultural parts of the county, which are unfit for agriculture because of their shallow and rocky character or steep and broken topography, are also covered with forest in various stages of growth and succession.

Except for the areas (at the present time continually growing) which have been burned over, this land is heavily forested with fir. The soil in these areas is usually clay or clay loam. Some areas are of Aiken Silty Clay loam, some are of Melbourne Clay loam, some Melbourne Silty Clay loam. Toward Blodgett and farther up into the Coast Range we have Olympic Clay loam. The particles of soil in these series are very fine where humus content is low. Under proper management, however, the humus content raises the size of the particles allowing for better aeration. However, the fineness of the soil particles is admirable for retention and solvent action of water.

Benton County lies in the Pacific Coast soil region. The residual soils are underlain by either basalt, andesite, dolerite, sandstone or shale. The sandstone formation is quite extensive in the western part of the county, while

the basalt and other igneous rocks border the Willamette Valley. The igneous rocks give rise to the Aiken, Olympic, and Cascade series, and the sedimentary rocks to the sites Melbourne, and Carlton series. (40)

Soil texture not only exerts an important effect upon the water relations but also upon aeration and supply of nutrients. It profoundly affects the rapidity of the processes of decay of organic matter and its relation to leaching. The nitrogen content of the soil, is, therefore, closely related to its texture. The total mineral elements needed for tree growth might be listed as nitrogen, calcium, potassium, magnesium, iron, sulphur, and phosphorus. The growing forest is a very economical user of these elements and finally,when the crop is harvested,the amount removed in the merchantable logs is still relatively small even after 100 years accumulation, for tree boles contain relatively little ash and nitrogen, most of it being in twigs and leaves. Branch and twig wood contains from two to six times as much potassium as bole wood,weight for weight, one to seven times as much lime, and four to twenty times as much phosphoric acid. Furthermore, in our Douglas fir forests, the cutting adds more than a single year's leaf crop to the soil and these leaves are rich in nitrogenous and ash constituents. The net loss over the entire rotation of our second growth Douglas

fir is, annually only about 2 lbs. of nitrogen and potassium per year, 6 lbs. of calcium, and 1 lb. of phosphoric acid. (4) The remains of the forest, after cutting, go into the soil by a gradual process of decay which spreads the benefits of the added minerals over a long period of time. The growing forest depends for its nutrition largely upon the mineralization of this litter.

Most of the humus material and the humification processes occur on top of the soil. As the process continues some of the soluble humus is leached into the topsoil, which is very porous and absorptive to a depth of 4 inches or more. In Benton county, however, the practice is to burn the slash resulting from cutting. What represents the accumulation of years is burned in a few minutes. Nature's method of renewing the soil is then partially thrown out of balance. The result is immediate enrichment of the soil in available nitrogen and ash materials. The long time result is impoverished soil and reduced tree growth. Studies indicate that one burn will not show appreciable reduction in growth but repeated burns most certainly do. (17)

Water Content. The water content of the forest soil is of great importance in reference to the minerals. All substances that enter plants do so in solution. It serves as a medium of transport of food materials in the plant

itself. It keeps the cells turgid or stretched, a condition essential to their normal functioning. It also prevents excessive heating of the plant, acting as a buffer in absorbing the heat generated by multitudinous chemical actions taking place in the plant.

The amount of soil moisture available to a tree is dependent partially on the water-holding capacity of the soil. A high water content of the soil may in part make up for dryness of the air.

Water is contained in the soil in three different ways: as ground or gravitational water, as capillary water, and as hygroscopic water.

Ground water is the name applied to the water in the saturated zone of soil rock. Capillary is the second and most important form of water in the soil since it is this water that is most commonly available to forest trees. It clings to the soil particles in a state of tension which just balances gravity. (8) The rise of this water from the water table is not unlike that of kerosene in the wicks of oil lamps. Hygroscopic water is the moisture absorbed by the soil particles from the atmosphere. (48). It is held so tenaciously by the soil colloids which coat the rock particles that it is unavailable to plants.

The retention of water is dependent on soil texture,

soil structure, amount of organic matter in the soil, and general atmospheric conditions. Clay soils such as are found in Benton county, will retain more moisture than sandy soil: a soil in good tilth, as a result of proper silvicultural management, will hold more water than a hard, compact one; and, a soil with plenty of humus will retain more water than one in which there is little or no humus present. The amount of moisture retained in the soil has a profound affect on the development of the roots. So much in fact, that the growth of roots has been found to be inversely proportional to available water content of the soil. (19).

Soil Aeration. The amount of air space in soils is from 35 to 50 per cent of their volume, and, when soils are in their best condition for the support of vegetation, about one-half of this space is filled with water, the other half with air. The composition of soil air is different from that of the atmosphere, in that soil air usually contains a larger amount of water vapor, a higher nitrogen content, a lower oxygen content, and a larger amount of carbon-dioxide.

Soil Temperature. Soil temperature affects the rate of absorption of water, the germination of seeds, and the rate of growth of roots and all underground parts as well as the activities of micro-organisms. It is a great

accelerator of all chemical reactions and effects many physical processes taking place in the soil. (9).

Soil Solutes. Soil solutes originate in the decaying humus, from dissolved rock particles, from bacterial action or from root excretions. These solutes are present in the form of soluble salts of certain elements. They go into solution with water and are subsequently taken up by plants as raw materials. Some of these solutes are those of nitrogen, sulphur, phosphorus, potassium, calcium, magnesium, iron chlorine, manganese, and boron.

A variation of certain amounts of these solutes will cause either an acidity or alkalinity of the soil which, may or may not, be beneficial to the tree. The exact cause of acidity in the soil is not known but it always seems to occur where there is a dearth of oxygen.

FIGURE 15

Desolation - a case for skeletal planting.

SECTION XII

THE PHYSIOGRAPHIC FACTORS

Slope. The effect of the angle of the slope is important in more than one way. First, it determines, in relation to the height of the sun, the angle at which the incident rays strike the ground, and, therefore, the amount and distribution of radiant energy received by the soil. That this has an effect on the vegetation cover of a given area is plainly shown by the variation in the vegetation of the Santa Catalina Mountains of Arizona. (47). Since the sun is south of the equator there is an advantage in disposition of radiant energy to the south slopes. In other words the same amount of radiant energy must be spread over more ground on the north slope than on the south because of the angle of incidence. With Douglas fir the north slopes are therefore preferable in the southern reaches of the species and the south slopes preferable in the northern limits.

The angle of slope also determines the amount and type of soil accumulated. On vertical cliff faces and very steep slopes no soil can rest, and the substratum for vegetation is necessarily bare rock. Hillsides inclined at a moderately steep angle can seldom accumulate any great depth of soil and are much subject to erosion. It is only on gentle slopes and on flat ground that considerable depth of soil can accumulate and undergo the changes characteristic of soil development.

FIGURE 16

Douglas and white fir slowly winning the area from the brush species. North slope.

Slope or gradient may be defined as the angle formed by the surface of the soil with the horizontal. It indicates the relation of the surface of the site to the horizon. An important effect is the control which it exerts on run-off and drainage, and through these, upon the water content of the soil. Another important effect is the control which it exerts through insolation on the temperature and moisture of the surface soil. It also has some influence upon light, wind, and indirectly upon the distribution of snow. The depth of soil and water content varies almost directly with the gradient when the other conditions are similar. Due to better drainage, forest growth as a whole is better on land having a moderate slope than on areas that are nearly or quite flat. Also humus does not decompose as rapidly on flats. Moderate slopes are best for forest growth.

Earth Configuration. The configuration of the land surface, the direction in trend of the mountain chains, the nearness to the sea, are of great climatic significance. They very largely determine the direction from which the prevailing winds come, the humidity of the atmosphere, and the amount of precipitation. Differences in rock formations, such as the difference in inclination of the strata, cause differences in the vegetation, as they determine the soil, water supply and the location of springs. There is

also an effect on vegetation as a result of a difference in the angle and direction of stratification. Although the soil of valleys and dells is deeper, richer and more productive than that on ridges and on the shoulders of hills, forest vegetation growing thereon is more exposed to dangers from frost, due to atmospheric drainage. When the outmost ridge of a mountain mass is at right angles to the prevailing winds, the interior ridges are protected. On the other hand, when the prevailing winds blow parallel with the ridges, they follow the valleys, and the adjacent slopes are protected.

Altitude. Geographic climate is very much modified by altitude. The atmosphere becomes less dense as we ascend to higher levels. Because of this, it is incapable of absorbing and retaining as much heat. A fall of one degree C, in temperature, results from a rise of 300 feet in altitude. This lowering of the temperature is greatly modified however by the configuration of the ground and by the air currents. Thus valleys, coves, and dells may be more exposed to denger from frosts than the adjacent slopes at considerable higher elevation. Thus in the San Francisco mountains in Arizona, Douglas fir is often damaged by frost when planted in the yellow pine type at elevations much below its natural habitat. The reason for this is

that the air, chilled by night radiation, collects within low basins which are closed to free atmospheric drainage. Tender species should not be seeded or planted on such sites. They are more likely to succeed on the adjacent slopes.

Because of difference in growth in different altitudes, the forester should plant closer in the lower soils.

Exposure. The exposure of a particular site refers to its aspect with reference to the points of the compass. It influences forest growth chiefly through its effect upon temperature and soil water. A slope exposed to the sun and wind often bears a different vegetation from one less exposed to either. The amount of heat absorbed by the soil on a given site depends largely upon how near to the vertical are the rays of the sun that strike it. In our latitude, the rays strike the soil much more obliquely on north-facing slopes than on south-facing slopes; hence the former receives much less heat than the latter where the rays are more nearly vertical. As greater heat accelerates evaporation from the soil, southern exposures are also much dryer.

The south slope is warm and relatively dry. Except when too dry, as in parts of southwestern United States, humus disintegrates rapidly. The soil quickly dries out,

the vegetation starts early, and is often exposed to late frosts. Fires are more destructive than on north slopes.

Many of the site factors, and particularly the soil factors, are, in their duration and intensity of action, due to the physiographic nature of the site. Physiography, within a given climatic unit area, through its effect on local climate and soil, causes a variety of plant assemblages to develop, each of which has a more or less distinct physiognomy, as illustrated in the swamp forest, the dune forest, the river bottom forest and the river bluff forest. The intimate relation which exists between the physiography of a region and the groupings of its flora, is primarily due to the profound effect of physiographic form upon the water content and composition of the soil.