CONTINUOUS TIMBER PRODUCTION IN
THE DOUGLAS FIR REGION

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The type of timber management herein described and advocated is admittedly new and only partially tried. No attempt has been made to lay down a blanket rule to use in all cases. Such a treatment can never be successful. An attempt has been made, however, to present thought provoking information based on sound reasoning and in so far as possible tried and proven examples. Much of the philosophy behind the ideas is theoretical. It cannot be otherwise.

As more and more operators begin to see that working on this basis is not only desirable from the standpoint of public opinion, but is actually economically sound, the future of our lumber industry will be assured.

There are silvicultural and protection problems which, under certain conditions will prevent the working of this plan. However, over the entire area of the Douglas Fir region, a large percentage of the area is very well suited to sustained yield operation.

It is the desire of the authors to present such material that will encourage operators to view the problem with open minds. It is hoped that it will become evident that sustained yield management is not only a definite social necessity, but that it can be economically practiced on much of the Douglas Fir Region.
INTRODUCTION

Purpose and Scope

The purpose of this report is to show through studies of representative areas, the possibilities that exist for bringing our forest lands into continuous high quality production. Under a properly executed system of timber management, continuous production can be maintained.

Possibilities and Limitations

The methods used, however, must necessarily vary to fit local conditions. No blanket rule could ever be applied; no blanket rule is being proposed. The attainment of the end must come through intelligent application of certain fundamentals to form a plan for each locality. Moreover, current income must be maintained at the same time the plan is being carried out.

Some of the principles involved are necessarily new to the Douglas fir region although they have gone through complete development and trial during the past fifty years in Europe.

Selective cutting in the United States has been practiced and developed in several regions, notably in the South by Ashe (2), and in the Lake States by Zon. (13)

The development of trucks, tractors and new methods of road building and logging technique now make it feasible and profitable to log selectively and to remove trees in the order of their economic and silvicultural desirability.
The unique opportunity for the Northwest to apply intensive management directly to virgin forests has come about due to modern developments now in our hands. True, sustained yield forestry enters into the picture as a matter of course.

Kirkland and Brandstrom in their report "Selective Timber Management in the Douglas Fir Region" make the following observations: "The depletion charge for the industry as a whole is preventable by the following measures:
(1) Proper selection of trees and groups of trees for cutting, and (2) Proper selection of cutting areas throughout the region; and (3) Adequate protection of residual stand and regeneration groups from fire and other injury." (1)

In old growth stands the initial cut is ordinarily a liquidation cut of financially mature trees. These often consist of partially decadent trees. Light return cuts will then be made at short intervals. The purpose of these return cuts will be to remove such timber, over the entire area, that is most urgently in need of removal.

This method of selection should result in economically sound operation by removal of ripe timber leaving the most valuable residual stand, and providing openings for adequate reproduction at the same time.

The forest composition in the Douglas fir region consists of a number of species. Most of these species are quite tolerant of shade and are therefore in very dense stands.
Douglas fir comprises approximately 60 percent of the stand. Its light requirements vary considerably from seed germination to maturity. It requires openings for full sun at germination, becoming more and more tolerant with age.

Periodic fires during the past several hundred years have contributed to the wide distribution of Douglas fir. Extensive areas where clear cutting has been done insure a future for this species. (2)

Long observation in the forests of the Douglas fir region has led A. J. F. Brandstrom and Burt P. Kirkland to believe that the clear-cut spots will generate densely to the desired mixed conifer forest. (1) Where pulpwood, post, pole or saw-log markets permit, cutting for stand improvement may begin at the age of from 40 to 60 years. The same roads used to log the adjacent old growth timber may be used to log these areas. Such early cuttings cannot stand the cost of forest improvements constructed for their special benefit. Under the proposed methods these improvements are paid for and maintained by the high-quality large timber that is continuously being removed.

It must be remembered that any attempt at silvicultural measures is necessarily governed by economic considerations. With recent developments in transportation and logging facilities these considerations are no longer a stumbling block for such silvicultural management. Previous to these developments, machinery and transportation methods available
necessitated clear cutting on extensive areas in order to make the operation economically possible.

It is not expected that operators will at once accept such proposed silvicultural practices. Only by observation of a few far sighted operations can the example be set for region-wide acceptance. Methods will indeed vary according to local needs and individual judgments.
DEFINITIONS

Selective Logging or Partial Cutting.

"This method of cutting consists of removing a part of the stand of trees of merchantable size and leaving enough merchantable trees and young growth standing and undamaged by the logging to maintain forest conditions and form a nucleus of a later cutting." (14) The term selective or partial logging, within ordinary meaning, does not assume that all merchantable trees are cut and there is left only a scattered understory and occasional defective trees, or unmarketable species. Nor is it truly selective logging when the residual stand is left in such condition and location that its chance of development into a usable stand is impaired by hazards of fire and wind.

Generally, selective logging falls into three groups: (a) stand improvement, (b) recovery of investment in higher value timber, (c) meeting market requirements. And in case of fire or other natural loss, salvage may be a reason. It is evident, of course, that between these extremes there is a method where silviculture and economics can be combined in good forest management.

Is It Good Practice?

The fundamental idea of selective logging is sound; undoubtedly in this region, as elsewhere, there has been too much destructive clear cutting from the standpoint of good business and good forestry practice. In many methods of
selection, improvement can be expected, but in no case should it follow an arbitrary or even a uniform pattern. The whole idea should be flexible, that is, it should be adaptable to topography, timber, markets, capital, and equipment. The forest owner should test these various methods under the wide variety of conditions existing in the Douglas fir region, with the objective in mind of perfecting a system of partial cutting for his individual area that will produce logs at a reasonable cost, leave the woods in best possible condition for rapid growth, and avoid creating areas of high risk fire hazard which may offset all favorable conditions.

**Group Selection.**

Group selection and area selection is nothing more than clear-cutting in a small way. If these groups or areas are not too large or too small, they usually afford advantages of easier fire control and increased assurance of seed supply.

**Tree Selection**

Many factors favor tree selection methods. The uncut trees insure an ample seed supply; partial shade provides favorable soil and water conditions; trees that are released usually put on fast growth; scattered big trees can be removed with minimum damage to immature trees. But, there are also some disadvantages in this system. Stand deterioration may result; the intolerance of Douglas fir may cause transition to hemlock, cedar and other tolerant
species; if the cutting is severe windfall may result; damage may be caused by felling mature trees; and the slash may create a fire hazard because of the inability of applying broadcast burning methods. (14)

Cutting by Stages

As markets improve the modern logger in Douglas fir may undertake to obtain full economic returns from present old growth stands by practicing a method of cutting by stages.

In this method he would first remove windfalls in order to save breakage and obtain maximum return from these trees. The next cutting might be cedar, also to minimize breakage. The third stage might be the removal of the high grade fir when the market for such high-grade material is good. A fourth stage might include hemlock and true firs if the market for pulp wood products is good. The final stage would cut wood and other products from conky trees because removal of these is necessary in order to assure full use of the land for the second crop. Seed trees that will withstand wind should be left to insure reseeding in case of fire after the area is logged. Market conditions should determine the order of cutting. (14)

Sustained Yield

"Strictly speaking, sustained yield management of a forest means so handling the forest that there is cut therefrom in a given period no greater volume of timber than is grown upon the area." (14) Although harvesting the crop of
timber is the main objective, the management plan involves an adequate provision for a fairly prompt restocking of the cutover areas, and continuous care of the growing stock until it reaches the cutting or maturity age. Instead of the investment being liquidated by conversion as is generally the case on forest lands in the United States, it becomes a perpetual investment as in a trust or perpetual annuity, with a fairly normal stock of timber and a fairly constant return to growth at all times.

Sustained yield, as used in the concepts in this report, means any definite plan of forest management that goes beyond the liquidation of old-growth stumpage into practical forms of continuous production. It should not be limited to operations where the drain every year is offset by the growth every year. Such management must be flexible, and cutting must be done according to market and other operating conditions, as well as for salvaging timber damaged by fire, wind, or insects. It should be the principle of maintaining the return from the forest over its rotation period, or the time required to produce the timber of the cutting size desired by the owner.

The owner or operator should realize that each and every one of these methods has many disadvantages, and that he should not attempt any one of them until he can understand and analyze the complete plan for the method desired. Being able to do this, the forest owner will be able to choose a plan that will fit his individual forest unit.
Importance of the Problem

Lumbering in this region has been under way on a small scale for over one hundred years, and on a large scale for about thirty years. Regardless of the form of management taken there is probably plenty of virgin forests available to maintain a fairly high level of production for another twenty or thirty years.

About one-third of the Nation's saw timber supply remains in western Washington and western Oregon. (1) This seemingly unlimited supply of timber has greatly concealed the importance of the management problem in this region. "The prevalence of wholesale clear cutting in the region has created an impression, among foresters as well as lumbermen, that the forest management problem is a cut-over problem. (1) It is seldom realized that forests as a whole, especially the now existing stands, are producing areas which are greatly in need of management in order to keep them in continuous production.

Economic and Social

The supply of existing timber in the region, if looked at as a perpetual revolving fund of forest capital, is not too excessive considering that up to the present time about seven million acres have been stripped of their original forests, and that approximately 200,000 acres are being added to the cut-over land each year. (1)
As shown in the following table about 546 billion board feet of timber remain in the Douglas fir region, which is about equally divided between private and public ownership.

**TABLE I.**

<table>
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<tr>
<th>Western Oregon</th>
<th>Western Washington</th>
<th>Total</th>
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<tr>
<td>Million Ft.B.M.</td>
<td>Per Cent</td>
<td>Million Ft.B.M.</td>
</tr>
<tr>
<td>Private</td>
<td>137,043 46</td>
<td>123,678 50</td>
</tr>
<tr>
<td>National Forests</td>
<td>112,599 37</td>
<td>88,488 36</td>
</tr>
<tr>
<td>Other Public and Indian</td>
<td>51,151 17</td>
<td>33,089 14</td>
</tr>
<tr>
<td>Total . .</td>
<td>300,793 100</td>
<td>245,255 100</td>
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It is amply shown by examinations of cut-over lands that methods of maintaining productivity on those lands are lacking. Recent strip surveys made in connection with the forest survey on private lands logged in the period from 1920 to 1923 inclusive, totaling some two-hundred miles in fifteen different counties of western Washington and western Oregon, show the following degrees of restocking:
The forest survey also shows that on the average 3.9 per cent of the land logged since 1920 has been burned over every year. "The conversion of forests into waste lands or into poorly stocked stands of open-grown, low-quality trees is certain to be followed by declines in industry, wealth, population, and tax revenues." (1)

The maintenance of a productive forest resource and its relative capital value is probably the most important problem that the public and the industry of the Douglas fir region must solve. It is a problem that should be considered not only in the region alone, but in all other communities that are connected or dependent on the supply of the resource. Even if the supply of timber of the region is ample for some time to come, even under most any form of management, serious difficulties usually result in local communities where the supply of available timber is exhausted. Larger cities in the region are already experiencing the effects of a depleted or a near depleted supply of the resource, and are faced with a serious blow to their economic and social structure. Depressed real estate values, and

TABLE II.

<table>
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<th>Sample Restocking on Private Cut-Over Land (1)</th>
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<tr>
<td>Well Stocked</td>
</tr>
<tr>
<td>Medium Stocked</td>
</tr>
<tr>
<td>Poorly Stocked</td>
</tr>
<tr>
<td>Non-Stocked</td>
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lack of confidence in the future, along with anticipation of a greater decline of industry and population, upsets the smooth working of community life and the stability of capital values. This is not an idea of what might happen to forest supported communities, it is a reality which has wiped out many small settlements that have been supported temporarily by a forest which seemingly was inexhaustible.

If the forest lands of this region are to be kept in continuous productivity to support the people, the industry and the community must be erected on a permanent basis in order to provide a continuous supply of raw material. If the lands are not kept productive the industry will naturally have to shift to other places, the community will have to shift with the industry, this process may again be repeated, depending of course on the permanence of the resource. Even if the land is under sustained production, the shifting will still take place if the supply of timber is intermittent. When the supply ceases, even for a short time, the industry must close down or move to another location. Such intermittent supplies of resources and short lived plants are almost sure to cause a great loss of both human effort and community value.
BRIEF HISTORY AND DEVELOPMENT OF LUMBER INDUSTRY IN THE DOUGLAS FIR REGION

Importance of the Industry.

Since the earliest times the forest and its products have been of the greatest importance to the Pacific Northwest. Even the founding fathers recognized this, and on the Oregon shield, or coat of arms, they inscribed a forest and a ship. Ships were and are the chief carriers of the northwest's chief product.

Today, fifty-five cents of the northwest's industrial payroll dollar comes directly from the forest, and approximately ten cents more is wholly dependent on activity in the logging camps and sawmills. It is little exaggeration to say that good or bad conditions in the lumber industry are immediately felt in almost every community in Oregon and Washington.

First, power-sawed boards in the northwest came from a water-driven sawmill, manned by two white men and some twenty Sandwich Islanders, at the Hudson Bay Company's post at Vancouver on the Columbia river. That was about 1821. But the first impetus did not come until 1849, when it came with a rush.

The horde of miners in California needed lumber. The few small sawmills that had been erected at Oregon City and other Willamette Valley points were suddenly swamped with orders for lumber at any price. There was a shortage of
help in the Oregon country, for most of the able-bodied men had already left for the California mines.

But old men, boys and even a few women turned out to man the little mills which worked day and night. They did pretty well, too, for there is record that on November 1, 1849, ten ships were in port at Oregon City, either loaded or being loaded with lumber totaling 1,485,000 feet and valued, according to the Oregon Spectator, Oregon's first newspaper, at $148,500. These cargoes date the industry's beginning.

Steam Power

The marvel of steam entered the industry in 1850 when the company of Reed, Abrams, and Coffin, built a steam sawmill at what is now the foot of Jefferson street in Portland. The machinery came in by boat and the builders were a long time getting it installed.

Steam made rapid progress in the lumber industry of the northwest. By 1870 all of the larger mills were steam-powered, and little more than a decade later the logging end of the industry was going in for steam in the shape of the Dolbeer donkey engine, devised and patented by John Dolbeer of Humbolt Bay, California.

The Blackman brothers of Snohomish, Washington, and Simon Benson of the Columbia river were among the first logging operators to use locomotives and railroads in the timber. These and the Dolbeer donkey engine soon replaced the oxen or bullteams as they were called.
Migration of Lumbermen to Coast

The Northwest's lumber industry moved very gradually until the 1890's when the more advanced group of lumbermen from the Lake States began buying timber in this region. By 1900 the movement of loggers and lumbermen from Michigan, Wisconsin, and Minnesota, was a real migration, to be followed a quarter of a century later by still more lumbermen from the Southern pine region.

In 1905 Washington suddenly took first place among the lumber producing states of the nation, a position it has held ever since, except for the one year 1913. Oregon took its place next to Washington in 1920, and still holds it.

A Change of Thought

More important than the amount of timber cut, is what is being done to assure a continuous crop of timber for all time.

In the Northwest today there are many lumber concerns that have been in production for seventy years, and many more for a half century or more. Some, as stated above, came from the Lake States, and others from the South; still others began where they remain today. All of them have seen the tragic waste of forests that took place elsewhere, and you do not hear talk about "timber enough to last forever." The talk has finally turned to conservation measures. Selective logging is a term the public is sure to hear more about.
The Logger Thinks of Conservation

Several of the large operators have their own private nurseries from which selected stock is removed for planting on areas which are deforested and will not reseed naturally. One private nursery near the Columbia river sets out two-million seedlings annually.

But if given a chance, nature herself is the best forester. Fire has been the greatest enemy to our forests of this area. Thus in all modern logging camps of the northwest, one will find fire equipment that would astound an old time logger whose only idea on the subject was to refrain from knocking live coals out of his pipe in the dry season of summer. Regulation fire hose, tank cars, gasoline-driven pumps, and all sorts of smaller equipment are part of every logging camp of any importance.

Most camps have a hygrometer, an instrument for measuring the humidity in the air. When the figure drops to the danger point logging ceases, either by state law or by agreement of members of logging and lumbering associations.

Several of the larger firms have their logging operations planned in a cycle, which, if carried out as now intended and as currently practiced, will allow them to harvest timber in progressive cycles.

Another advancement in the lumber industry of this region is the increasing attention given to utilization of what were formerly waste products. Boxes for berries and fruit use much of the low grade lumber, while the slabs and other
similar materials that once went direct to the refuse burner, are now ground into "hog fuel" and sold to industrial concerns and to home owners for burning in sawdust burners. One large company has recently invented a machine for pressing sawdust into log-shaped sticks for use in stoves and fireplaces.

Today the marketing of the product of the log is of vastly more importance than the cutting of that log in the forest. This makes a more stable industry than in the days of "cut out and get out," the policy so largely followed by the sawmills from Maine to Minnesota. There is nowhere to "get out" to from here, no "further west." This is the far end of the timber line. The lumbermen have fully realized this, and through cooperative effort in their associations they have made an attempt to regulate supply and demand. The associations have their trade promotion departments, but it is also significant to note that they also have their own forestry departments.

Twenty years ago the term "forestry" was not recognized by the average lumberman. In 1938 not only do lumbermen pay to support forestry departments in their associations, but many individual lumber concerns have their own foresters, both for technical advice and future planning. (15)

The Responsibility

Either directly or indirectly, a large percentage of the business done by other industries, by the banker, by the far-
mer, and by the professional man, exists as a result of turnover and distribution of income derived from the sale and manufacture of forest products. Many areas depend entirely on the forest for their support. The forest resource supports, to a large extent, the economic and social life of the entire region.

In order to maintain these social and economic benefits, continuous supplies of forest raw materials must be obtained. With proper management, and with soil and climatic conditions as they are in the region, the existing forests are capable of continuous production.
DESCRIPTION OF THE GENERAL SITUATION

The Douglas fir region extends from the Pacific Ocean to the top of the Cascades in Washington and Oregon, and from British Columbia to approximately the California line. Almost the entire area was once forested with the exception of prairies, meadows and a few barrens.

Past Practices

In the broader sense this is still a primeval forest. Of 28,000,000 acres of original forest only about 1,000,000 acres have been logged. (3) It is estimated that at the time the white man came to this region the forests were not over one-third productive. The average stand for the region as a whole is estimated to have been less than 30,000 board feet per acre on land that should produce crops of 100,000 board feet per acre. Serious inroads of fire had altered the composition of the forests to a point where many types and ages were in existence. As a result of these repeated fires, large areas of second growth timber are now existing. Their presence has a great bearing upon the future stability of the lumber industry.

Present Conditions

Extensive lumbering operations up to the present time have been very largely confined to mature and overmature stands. As the easily accessible old growth timber has been removed, a few operators have gone into the older second growth stands for their raw material. This timber is much
less decadent, knots are generally intergrown and tight. Good lumber of medium grades is being produced from these areas.

**Attitudes**

The logger, the lumberman, the forester and the "man on the street" are beset with ideas not wholly in opposition to each other but often misunderstood to the point of controversy. The following quotation from the Twenty-Seventh Annual Report of The State Forester of Oregon is worthy of repetition. (14)

"The timber operator is not a devastator in the sense that the term is usually used. A prominent forester once said that 'between the primeval forest and the cultured forest there is always devastation.' Large timber and powerful machinery is a combination that contributes to devastation. It cannot be otherwise. But this devastation is only temporary. Through proper protection and handling, the devastated areas will soon become growing forests. It is a necessary step in the transition of old forests to the new."

A survey of trade journal articles by leading loggers would seem to indicate considerable opposition to the practice of selective logging in the Douglas fir region. To some it is deemed possible in some dim distant future; to others it is entirely impractical for application in the Douglas fir region. In an article by Charles O. Marston, logger, in the West Coast Lumberman for March 1939, the idea of economic or silvicultural selection is completely rejected. He maintains that slash cannot be burned in accordance with present requirements without consequent damage to the residual stand and to reproduction. He states that se-
lective logging further endangers remaining trees to windfall, and causes many openings for fungi to enter. Clear cutting by stand or compartment method is more generally advocated by the logger.

The forester seems to see the matter in somewhat the same light, however he generally believes in public ownership of lands which are not under suitable private management. B. E. Hoffman, U.S.F.S., in his article "Pulp Timber Forestry in the Douglas Fir Region," (6) makes the statement that public ownership of large long-term supplies of timber appears to be a necessity to help the operator in meeting the heavy burden of carrying charges under private ownership.

Problems of ownership are not altogether simple. Economic and political questions complicate the determination of how much forest land the public should own and what should be held under private ownership. Private forestry needs the support of the public in adjustment of taxation, strengthening of protection from fire, and certain forms of research.

It seems that both the logger and the technical forester want ultimately the same thing--continuous timber production. The only point of controversy then lies with methods of obtaining sustained yield.

Certainly the public is in favor of sustained yield or continuous production of high quality timber. Their very existence depends upon the future of the wood using industries.
Over 50 per cent of the population of the Douglas fir region is supported either directly or indirectly by the wood using industries. (4) The heavy payments of taxes by timber owners tend to materially reduce the tax burden on the general public.

The problem of obtaining continuous productivity of our great renewable resource, timber, lies not with the ultimate desires of the individuals concerned, but only with the methods by which sustained yield is to be brought about. Experiments now in progress will go a long way toward offering a possible solution which must in any case be flexible enough to be applicable to local situations.
FUTURE TRENDS

Markets

In considering the market possibilities, both present and future, the existence and operation of operations engaged in the liquidation of certain areas cannot be overlooked because of their effect on the management program of the Douglas fir region. If clear cutting were the most economical, then destruction of these smaller units might be inevitable. "The fact that selective cutting is more economic, with respect both to immediate returns and to preservation of future values, makes complete liquidation undesirable." (1) As we look at the situation today, the operators that have been and are liquidating their timber have preempted to themselves an undue share of market outlets in proportion to the timber acreage held, and by occupying this position they hold a privileged spot in this respect, thus, they are preventing the marketing of a legitimate output of sustained yield operations throughout the entire region. No doubt it will take a considerable time to correct these practices, but their effect on the welfare of the community, and the region as a whole should soon bring the attention of all concerned. The selective policy should be so designed to supply the market with high value logs.

In order to eliminate destructive liquidation, to bring about sustained yield, and to introduce an orderly
economic system to marketing the region's timber resources, we should have a consolidation of existing small units with existing units that are large enough for sustained yield management. If the markets are fairly divided among all management units, both public and private, there should be sufficient outlets for nearly all sustained yield products, and all markets existing in the past could surely be fully supplied.

**Quantity or Quality in the Future**

It seems that, generally speaking, the lumber industry assumes that a forest management program would produce relatively small-sized and low-value material. But it should be remembered that unless adequate provision is made for continuous production of large-sized, high-quality timber the most profitable industry of the region will not long be able to maintain its existence. The plywood industry, which depends entirely on high-quality material, is still making great progress in its field. The lumber industry itself which uses the greatest amount of material from the forest depends to a great extent on its ability to secure high-quality material. If the supply were cut off, most of the higher priced items which find their way on the world market would drop out of the picture. It is highly important that high-quality material be supplied in the future, usually all the profits are secured from the sale of these higher-quality products, and in many instances a loss is incurred from the manufacture and sale of low-quality
material. Because the higher grades pay the costs of logging and manufacturing it is necessary to have them in order to operate a forest area at all.

If we continue to let the supply of high-quality timber diminish without providing for the future there is no way to escape the loss of those much needed foreign and domestic markets that are necessary for the industry to exist. It is almost impossible for low-grade lumber to pay its way and compete in distant markets. This is true particularly in the eastern markets for these grades of western woods. The southern pine region has the advantage both in nearness to market and the producing ability of its forest land.

Although the supply of large timber is of first importance, smaller trees, which necessarily must be removed from the forest in the management process, will tend to balance the industrial program in the region. For example, the preservation industry uses sound, straight trees, varying from post to piling sizes in producing very high-quality products. The smaller trees also provide excellent lumber of common grades, and are used in this way even though the cost of logging and sawing is higher than for the larger trees. A continuous supply of these common grades at a reasonable cost should have a beneficial effect on the continued demand for finished lumber, plywood, and other high-quality material produced from the larger trees. Undoubtedly the local market on the coast will continue to absorb much of this common grade material, even though distant
markets may be increasingly supplied from sources nearer them. Therefore, it seems reasonable to believe, taking all grades into consideration, balanced production will be necessary if large market outlets are to be assured in the future.

**Future Chemical Utilization**

"It should be noted that although lumber continues to constitute about half of the wood utilized from American forests, some persons believe that existing trends in utilization indicate that wood fiber products, chiefly pulp and paper, may eventually become the major products of the forests." (1) However, even if "cellulose forestry" should increase in importance far beyond what is now anticipated, the program of forest management is still good business. Generally in this region, the larger trees can be grown and logged more cheaply than can the less valuable smaller trees. Under any conditions yet anticipated in the chemical industry, saw-timber forestry should pay its own way and provide as a by-product all of the pulpwood products that can be used, whereas the pulpwood, if produced separately, would have to bear all the costs of management for the area. In this way selective management offers the best method and most practicable means of maintaining a ready-grown stand of pulpwood species of already proven value. Selective timber management favors the regeneration of these pulpwood species, whereas, extensive clear cutting favors the regeneration of Douglas fir, a species as yet of very limited use in the pulp industry.
ECONOMICS

Limitations

There are certain definite limitations upon the economic aspect of sustained yield management. The enormous amount of mature and overmature timber, combined with the problem of forced liquidation of smaller private holdings, has flooded the market with such a supply of raw material that stumpage prices have been forced below the limit for sound economic management upon a sustained yield basis. This has resulted in a discouragement of private participation in management for continued production. Then too, much of the private timber land is divided into areas too small for individual management.

The possible trends in demand based on a long rotation is difficult to predict. Operators and timber owners have been reluctant to assume high carrying charges and overhead costs without a reasonable assurance of getting their money back.

Changing Conditions

Changes in utilization have presented a new picture. The rapid development of chemical utilization of wood makes one wonder just what the future demand will be for trees of sawlog size. With the increased utilization of "inferior species" for paper pulp the picture is changing. Certain far sighted operators predict a strong demand for hemlock and white fir. A few operators are working on a selective logging plan with the idea of getting a positive cash return
for their now profitless hemlock. The fact remains that regardless of future market conditions it is economically unsound to cut trees below the margin where returns equal costs.

Slash Disposal

Slash disposal is a serious problem in the Douglas fir region. State laws require the burning of all slash. Best silvicultural practices deny the advisability of the use of fire in disposing of slash. It has often been said that prevailing methods of slash disposal leave indeed a greater fire hazard after burning.

In order to arrive at any intelligent solution to the problem we must first consider certain basic factors. Such factors as density of stand, relative costs of burning and protection of unburned slash, and the amount and kind of reproduction secured under the various methods of slash disposal must be seriously considered. On thinly stocked stands the amount of slash left after logging is not of such quantity as to present a serious hazard. The damage to residual trees, reproduction and general site conditions will indeed be more costly than the added cost of more intense fire protection during the danger months.

Reproduction

The kind as well as the amount of reproduction must be considered before setting down a definite rule even for a local situation. In the Douglas fir, hemlock type, hemlock is almost sure to dominate the new stand unless certain
measures are taken to encourage the fir. Broadcast burning seems to retard the stocking of hemlock to the point that fir comes in abundantly. If Douglas fir is to be the desired species in such areas, slash disposal by fire seems to be a solution. If future markets are so changed, as well they may be, hemlock with its adaptability to chemical utilization might be the best economic consideration.
L. T. Murray has inaugurated the first large scale selective logging unit with the idea of operating upon a sustained yield basis.

For many years the West Fork Operation was fundamentally no different than any other of the large operations. The men followed the orthodox system of logging prevalent in the Douglas fir region. It was a "high-ball" camp in which production records were a matter of pride. The company operated on a clean cutting basis with sky lines in such a way as to reduce almost every tree to a prostrate position. Their timber was of mixed species of Douglas fir, hemlock and cedar. Only the best logs were removed, the rest being left on the ground to be destroyed by the slash disposal fire.

Some time ago Mr. Murray became convinced that loggers were not making the most of their economic opportunities by clear cutting and in so doing removed timber that they knew brought them an actual economic loss.

Mr. Murray's theory resolves itself down to the simple formula that it is good business to log and sell only logs that are in demand and which can be sold at a profit or at any rate without an actual out of pocket cost. In looking back over the operations in the Douglas fir region, Mr. Murray saw that it was the "weed trees" left the first time over that were actually bringing in a profit in the long run.
The pulp and paper industry of the Pacific Northwest is founded upon the premise that there will always be an ample supply of raw material from which to manufacture their products. It seems only logical then, to log only the larger timber most in demand by the log market at Puget Sound, and leave a residual stand fully or partially stocked with hemlock with which to supply the future demand for pulp timber. By means of permanent tractor roads the timber left can be logged at any time the market conditions seem to warrant its cutting. The smaller timber can still be counted as an asset if left standing to put on more growth.

Operation

In carrying out this theory of operation it was evident that previous methods of logging with high lead could not be practiced in conjunction with the selective logging plan. Up to the present time nine caterpillar units with arch, drum or bull-dozer attachments have been put to work on the operation.

In the major tractor camp three tractor-arch units are employed. Only about one-half of the timber is removed. The size of the trees cut is variable and can be changed in accordance with demand at any time.

Timber Types

While the percentage of hemlock in the West Fork Logging company's 250,000 acre holdings is large, Mr. Murray wants to leave as much of this species in the woods as pos-
sible. He is firmly convinced that higher prices will prevail on hemlock in the future. (8)

**Topography**

The tractors are working on ground that is fairly steep with grades as high as 15 to 20 percent. With good roads installed previous to falling it has been possible to get out as much as five carloads per day, with cat tractor-arch unit. The flexibility of tractors is one of their chief advantages for use under these conditions.

On certain parts of the operation where tractors cannot be satisfactorily used, a new form of high lead is put in. This low-high lead will not exceed fifty or seventy-five feet in height, just enough to get the rigging off the ground for a short distance. Chokers are changed as often as necessary to avoid knocking down trees. Another system of saving timber is to fly only one choker on a line.

Mr. Murray is an ardent exponent of hemlock but at the same time he has not overlooked the value of fir. The company hopes to maintain an adequate supply of fir to supply their current demands. In fact fir and cedar are the main items of production at present, and many thousands of acres are reseeding with fir seedlings.

**Slash Disposal**

Broadcast burning is also opposed in this theory of operation. Now very little slash is burned on the area and they have never had a serious fire. The largest fire was under thirty acres and that of incendiary origin. Perma-
nent tractor roads constitute a series of fire breaks, the importance of which cannot be minimized.

Public Acceptance

It is natural that this new scheme of logging will be looked upon with mixed feelings by foresters and loggers throughout the Douglas fir region. Some of the forester group feel that the system will work if no serious outside factors enter in to upset the balance. One argument that has been raised is that of the hazard of the unburned slash. Others seem to feel that the permanent system of tractor roads is an adequate check upon the spread of fire.

It has been stated that only hemlock reproduction will result from such selective logging. This is not in discord with the West Fork plan for Mr. Murray is staking his investment on the future rise of the price of hemlock timber with the expansion of the pulp and paper industry.

Another point with regard to injured trees has been raised. It is thought that injured trees may succumb quickly to decay. Mr. Murray is prepared to make regular cuttings of injured trees if conditions demand such action.

Taxes

Taxes present another source of expense. A quotation from L. W. Schatz, forester of the West Fork Operation is worthy of repetition.

"Under a system of clear cutting where a crop is harvested even as early as every 60 years, a 2 percent tax on the full land value with a 20 percent yield tax on the timber makes a tax burden two and one-half times as great
as under a system of selective cutting where cuts are made every ten years. Under the straight property tax the burden on clear cut lands would be twice as great. In either case the tax burden would be excessive but yet less burdensome with selective cutting than with the clear cutting system." (10)

**Benefits**

Mr. Schats summarized the benefits which have accrued to the West Fork Operation in the following manner:

1. Greater immediate profits.
2. Lower fire hazard.
4. Residual stands which are capable of yielding returns within a shorter period of time.
5. Public approval.

**Conclusion**

The fact that present methods of logging waste an enormous amount of sound timber is strongly on the side of selective logging. It is more sensible to save the timber not now merchantable in the form of growing stock and take a flying start at sustained yield, rather than to start from scratch. With such a realization of facts, the idea of selective logging cannot be pushed aside.
FIRE HAZARDS

Under a system of clear cutting and donkey logging, according to studies made by A. H. Hodgson, (11) the average quantity of slash per acre in typical Douglas fir logging operations amounts to about 43 cords (Approximately twenty-one thousand board feet) of sound material of cordwood size and larger plus 7 percent of the original cubic volume of the stand in the form of unusable broken pieces, decadent material, etc.

This slash does not all come from the trees actually utilized but is a result of the type of logging and the consequent heavy accumulation of debris.

The one main reason for the disposal of slash is an attempt to reduce the fire hazard present after logging. Oregon and Washington forest officials have recognized the danger and have usually required that the slash be burned.

If the area being logged is not intended for future forest use the problem is comparatively simple. The problem is then to comply with the state law and simply broadcast burn the area taking care not to endanger equipment or green timber. But if the desire of the land owner is to continue the growing of timber, the problem at once becomes more complicated. From a purely silvicultural point of view, it seems that no burning should take place, or at the outside only spot burning to remove the heaviest accumulations.
The idea of selective logging and sustained yield management makes the slash disposal problem a much more complicated one. The need for quick full stocking to seedlings, and the need for protection of residual trees makes the advisability of burning questionable. Often the standing timber killed by the slash fire results in an even greater fire hazard in a few years.

Changes in fire hazard as a result of cutting are due not only to an increased amount of material on the ground, but also to changes in local temperature and humidity. The opening up of the dense canopy allows the wind and sun to dessicate the debriz on the ground to a point of serious inflammability. The extreme hazard resulting from such an operation comes from clear cutting.

Gisborne, in a study of the effects of partial cuttings, observed that the removal of half of the timber from a given area did not result in a drying out condition half-way between that of a full-timbered area and one that had been clear cut. In fact the fire hazard on such an area more nearly represented the same conditions as those found on a fully timbered area. In other words, although half the crown canopy was taken out, the danger was not increased proportionally.

Selective logging, if properly managed, may present no greater hazard than the original conditions of the forest. If this be true, another strong point in favor of this type of cutting has been won.
Possibly the greatest forestry problem facing us today is the future ownership and management of cut-over forest land. Counties have proved themselves incapable of handling cut-over lands, in that they have reverted them to settlers with meager means for the purpose of farming this land which is unsuited both economically and geographically for farm lands. Unprotected areas of small second growth have been sold which should be protected and permitted to grow.

The Forest Service has shown no desire to take over these cut-over lands that fall to the counties, and it seems only natural that the logical owner and manager should be the State. As already mentioned, it is evident that a permanent forestry program can only be secured through large ownerships. Therefore, it seems, that the ideal would be a combination of state and private holdings into cooperative units, which should prove a mutual benefit to both concerned.

**Cooperation of Public and Private Forces**

Cooperation surely would go a long way in the solution of our problem in forest management. Management of forest lands is not an individual problem, it is a public problem. The public is the benefactor of the regrowth of our timber and should be willing to pay their share of the bill in keeping or making our cut-over lands productive. In the past the public has shared the benefits but few of the expenses.
Administration

There appears to be no definite line between policies which should be correlated by central authority and such other policies, especially of local administration, which should be determined by better informed local individuals. We should strive for as time, training and experience go on, as also do changes in local conditions occur, to have local individuals who become more, never less, competent to deal wisely and promptly with their own local problems, and problems of cooperation with other agencies.

Markets

Another point which must not be overlooked for the future management of our forest lands is the development and maintenance of markets for forest products. Unstable markets, labor disputes, discrimination in foreign markets, unlabeled foreign lumber in local markets, and inadequate tariff protection, are as much enemies of the forest as fires, insects, and disease. It is almost impossible to have a steady production of lumber and an assurance of steady employment, as long as there is a fluctuation in demands and prices of forest products.

The business principles that are involved in producing forest products are similar to those confronting all businessmen and all business enterprises that look ahead into the future. No other industry requires such a large outlay of capital as that of the logging and lumbering industry.
Thus, it seems reasonable to believe that the business of producing the raw products can prosper only as the business of manufacturing and marketing prosper.
POSSIBILITY OF SELECTIVE TIMBER MANAGEMENT
IN THE DOUGLAS FIR REGION

In order to have selective timber management in this region we should have a complete picture of the area, with respect to its forests, stumpage values, and stability and possibilities in future markets. Risk factors, decay, mortality, density of stocking, timber types, site quality, and rate of growth vary widely throughout the region. Stumpage values also vary widely because of topography, location, species, quality, and size of timber. Market fluctuations also occur from time to time which upsets the normal value relations between species and qualities of timber.

The rapid advancement of logging equipment and methods in the past few years has done much to bring about possible selective management for this region. They offer selective and flexible tools that are necessary for the operation of long-term management and current market selection. New logging methods have also brought a reduction in timber breakage, and in most cases a substantial reduction in logging costs. Much of the logging cost reduction is brought about by the economy of long-distant tractor road- ing and in the substitution of motor roads for railroad spurs. "The initial and maintenance cost for this new system is less than one-third as much as in the old system of donkeys and railroads."
Liquidation of Overmature Timber

The first aim should be to liquidate quickly the financially most overmature portion of the timber capital. In the majority of cases, the trees taken in this cut would consist of stagnated old growth timber which under normal conditions has a very high stumpage conversion value. It is also possible, in some instances, to salvage merchantable windfalls, or other dead and rapidly deteriorating material that might be on the area. A serious loss would be suffered if liquidation of these nonproductive or declining, though generally high-value elements of the stand, were long delayed. Mortality, decay, other risks, and especially, discount of long-deferred income work together to make a heavy financial pressure for early liquidation.

To prevent these losses it is necessary to have a net-work of roads in the area to facilitate a light cut. The savings effected through this hastened cut of only a small portion of the overmature timber will in most cases more than pay for the road system. Other necessary measures such as snag felling and fire protection should pay for themselves in the same way.

Permanent Road System Important

A permanent road system gives convenient and quick access to all parts of the operating area. It places the growing stock under complete selective control, and in this way is as much a part of the forest as the land and trees themselves. It allows short cutting cycles and light cuts.
It allows market selection and effective fire protection. All of these help the attainment of maximum operating efficiency.

The logging operation should move back and forth aiming generally to remove that portion of timber that is most urgently in need of removal. This keeps logging closely in line with market conditions. Also, fire-killed, bug-killed, and otherwise damaged timber can be salvaged before serious damage takes place, usually in the course of the logging operation. Also, the bulk of the cut is ordinarily taken from the mature, generally more valuable, part of the stand, thus, having a steadier supply of high grade timber. Whenever markets permit, low grade material should be removed, that is, sanitation cuttings in old growth, and improvement cutting in second growth stands. The removal of such material should increase rather than decrease future returns.

**Growth**

Generally speaking, in old growth, the growth is offset by mortality. If through a management plan we can remove the rapidly decaying and slow-growing trees and give the younger trees more room to grow and develop, it seems only reasonable that growth should naturally be increased to a great extent.

In this way favorable conditions should be created on the area for the successful regeneration, survival, and management of new growth, because the forest area will retain
for the most part the climate with its natural moist growing conditions and relative safety from fire, and also provide a permanent system of roads, a permanent logging organization, and fairly intensive fire protection. Natural high density in stocking should result, which gives full use of the soil for both quality and quantity production.

Silviculture and Fire Protection

No attempt has been made to set forth a definite program of silvicultural and fire protection methods. The recent development of this region gives us only a limited supply of past field experience to draw from, thus, no set of rules can be given as to how these problems generally should be handled. The many details which this problem naturally brings up, no doubt, will have to be worked out on the ground for each individual forest property. From the silvicultural point of view, it should be remembered that the selective program provides for a permanent road system and selective control of the growing stock. The selective program should provide for group selection, that is, clear cutting, as well as individual tree selection. In introducing a selective system on a large forested area the immediate problem should be how to get the growing stock in the most productive condition, and not how to get regeneration. No doubt, it will be several years before all stagnant forests are cleaned up and put under selective control. As this is taking place results may be obtained and studied from these various forms of selective cutting,
and from these studies the future course can surely be determined.

"The main points in a sound fire protection program are to preserve the forest climate, to maintain a fire resistant stand, and by means of a permanent road system to promptly utilize matured timber and salvage timber killed by fire, insects, and other destructive agencies. Through these measures and through giving time for widely distributed slash to decompose and return to the soil, selective management aims at gradual attrition of the inflammable debris in the forest to the point where fire hazards will be less and fire control more feasible than under existing conditions." (1)

**Returns from Management**

Selective management which is applied to well stocked areas with a longtime supply should bring a high immediate and also provide a substantial sustained income.

"The guiding principle in balancing plans for immediate income against provision for high future returns is to manage a property for its highest capital value, as determined by discounting a series of deferred annual incomes to their present net worth—a principle that is recognized in all branches of investment management, as for example in life insurance, banking, farming, and real estate. This means that attention should be given not only to current income but also to capitalized value that remains. It means essentially that liquidation of timber should take place in an orderly manner, while remaining amply flexible for immediate response to changing market demands and prices." (1)

**Bare Land or Existing Timber**

When we think of timber growing in this region, we usually think in terms of bare land. Even at its best, the enterprise would start with an investment in logged-off land and also a cost in planting the area, and then probably for a hundred years or more that annual expense of administration, protection, and taxes. Then compound interest, with rates high enough to cover the risk involved, will soon run
the investment into a relatively large amount. In other words, the timber grower must start from scratch. He cannot be sure of his future costs and returns. He must spend money at present for uncertain returns in the future, returns that will no doubt be realized beyond his lifetime. It is very discouraging, working against compound interest and those many years with money constantly going out and nothing coming in.

Selective management on already established forests presents a much different picture. Selective liquidation will absorb the current costs, and together with managed control of growing stock of the existing timber, the forest will gradually be brought to its maximum productive capacity.
CONCLUSION

The writers of this paper have in no way attempted to set up hard and fast rules for a program of selective timber management in the Douglas Fir Region, but have tried to bring to light their ideas and also the ideas of selected authorities on the subject. Experience and results in this field are limited, but it is hoped that each reader of this paper may obtain some idea which he may be able to capitalize upon either in a way of conversation, or possibly some future study.

The main objective of selective management is the perpetuation of existing forest resources at a high level of continuous productivity. Building up a new stock with adequate representation of diameter classes would require work of many centuries, but carrying on an existing stock with these diameters already represented requires only continual reservation of medium-sized trees to grow in the place of the large trees as they are cut. In a similar way, small trees already existing will replace the medium trees, and regeneration ever coming in where space is provided will take the place of the smaller trees. All of these progressions taking place in an orderly manner in a forest already well stocked requires no long-time financial investment and no accumulation of annual costs at compound interest. If good management could be attained for each
established forest property within the region, surely there could be maintained forest value, forest industry, income to labor, and a continued safety in community security. A forest management plan, with maximum soil productivity as an objective, that does not consider these views surely will not preserve the resource that is so highly important to this region.
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PLATES

I  Map of Douglas Fir Region.

II Unsatisfactory restocking as the result of fire.

III Adequately protected cutover area with an abundance of reproduction.

IV A. Modern logging road construction.
   B. A Typical stand of second growth fir.

V Wasted hemlock left after logging due to condition of market.

VI Typical cutover area under old system of logging with no chance for natural restocking.

VII Felled timber before being removed, under the selection system on the West Fork Operation.

VIII A selectively cut area on the West Fork Operation after the removal of 60,000 board feet per acre.

IX A selectively cut area on the West Fork Operation after the removal of 150,000 board feet per acre.

X West Fork Operation. Old type skyline used on the swing under the selective system. Note the narrow swath through the standing timber.

XI Modern yarding and roading equipment used on the West Fork Operation.

XII Oldtype skyline adapted to fit the selection system of management. West Fork Operation.

XIII Heeling boom used in loading cars. West Fork Operation.

XIV Type of material removed under economic selection. West Fork Operation.
FIG. I
MAP OF OREGON & WASHINGTON SHOWING
THE ELEVEN FOREST UNITS OF THE DOUGLAS FIR REGION
PACIFIC NORTHWEST FOREST EXPERIMENT STATION
FOREST SURVEY
1935

1. NORTH PUGET SOUND UNIT
2. CENTRAL PUGET SOUND UNIT
3. SOUTH PUGET SOUND UNIT
4. GRAYS HARBOR UNIT
5. COLUMBIA RIVER WASHINGTON UNIT
6. COLUMBIA RIVER OREGON UNIT
7. WILLAMETTE RIVER UNIT
8. NORTH OREGON COAST UNIT
9. UMPQUA RIVER UNIT
10. SOUTH OREGON COAST UNIT
11. ROGUE RIVER UNIT

Plate I
Plate XIV