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forestry**

The Col. William B. Greeley Lectures
IN INDUSTRIAL FORESTRY

number

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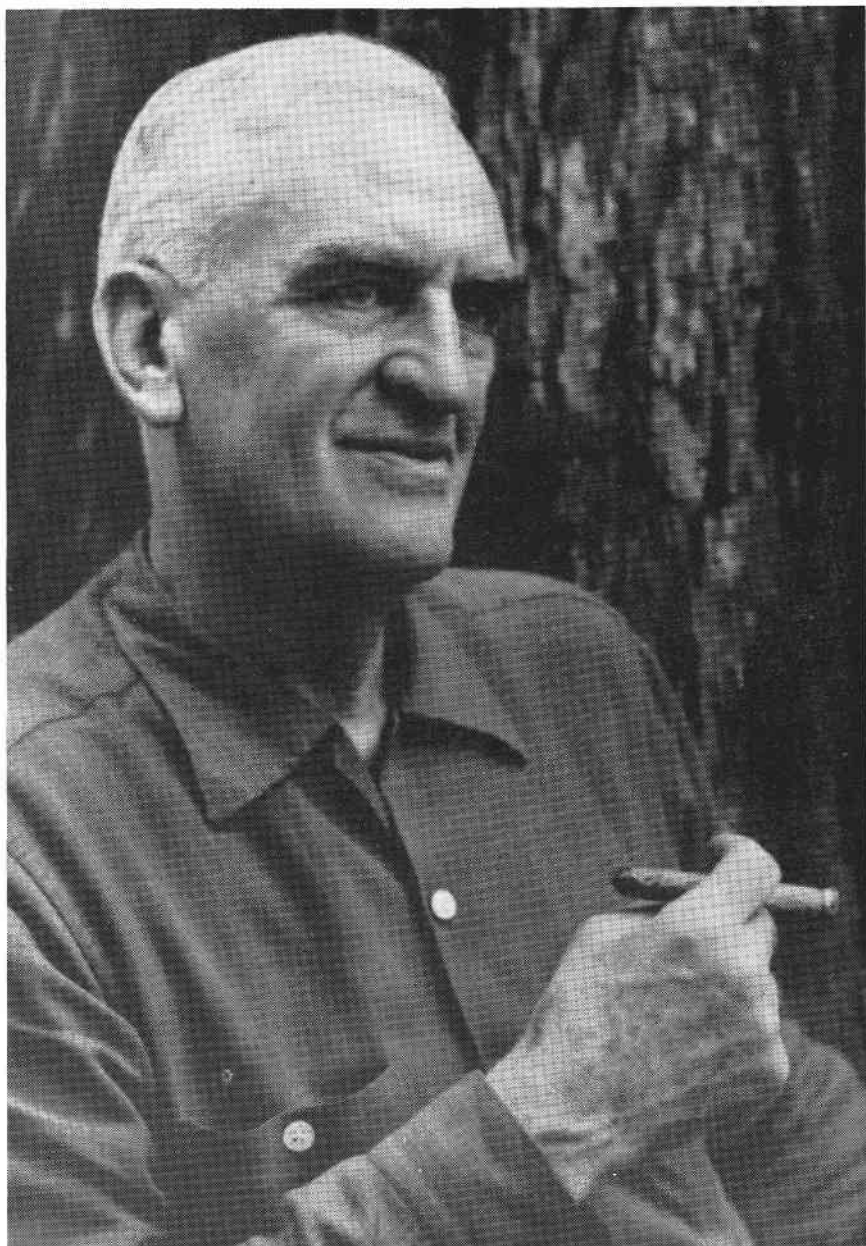
THE COLONEL WILLIAM B. GREELEY LECTURES
IN INDUSTRIAL FORESTRY

NUMBER FOUR: *The Development of Industrial Forestry
in California*

By Emanuel Fritz

UNIVERSITY OF WASHINGTON
COLLEGE OF FORESTRY

●
SPRING, 1960
SEATTLE



Emanuel Fritz

FOREWORD

In 1956 the Industrial Forestry Association made a grant to the College of Forestry providing for a series of lectures in industrial forestry. This gift was presented as a memorial to the late Colonel William B. Greeley, who was one of the pioneers in industrial forestry and the founder and director of the Industrial Forestry Association. In making use of the grant, which extends over a five-year period, it was decided to select speakers from various sections of the country who could speak on the development of industrial forestry in their areas.

The California Pine and Redwood Regions with their tremendous stands of virgin timber and their recent developments in industrial forestry were selected as the fourth area in this series. Prof. Emanuel Fritz, who has been closely associated with the development of industrial forestry in California, particularly in the Redwood Region, was chosen as the fourth Colonel William B. Greeley lecturer.

Professor Fritz was born in Baltimore, Maryland; received a degree in mechanical engineering at Cornell University in 1908, and the degree of Master of Forestry from Yale University in 1914. He was an instructor in the Engineering Department of the Baltimore Polytechnic Institute from 1908 to 1912. From July, 1914, to January, 1915, Professor Fritz worked in the Forestry Department in the State of New Hampshire, and from February, 1915, to August, 1917, with the U.S. Forest Service in Montana, Idaho, and Arizona. As a captain during World War I, Professor Fritz commanded the 639th Squadron of the Air Service of the U.S. Army. Upon release from the Army he became a member of the Forestry Department at the University of California, where he taught lumbering and wood technology from July 1, 1919, to June 30, 1954. In 1954 he retired as Professor of Forestry Emeritus. Since 1934 Professor Fritz has served as a consultant in forestry, lumbering, and wood technology, and since 1954 has been vice-president and technical adviser for the Foundation for American Resource Management. He has been an active member of the Society of American Foresters and served as a member of the Council from 1931 to 1933; as associate editor of the *Journal of Forestry* from 1921 to 1929; as editor-in-chief from 1929 to 1933. He was elected a Fellow of the Society of American Foresters in 1951. In 1947 he was given the *Journal of Forestry* Award for the best article in the *Journal* in 1946, and in 1955 was given the Western Forestry Award by the Western Forestry and Conservation Association. Professor Fritz is the author of more than two hundred articles on forestry, wood, and lumbering.

This publication embodies material which was presented by Professor Fritz in a series of three lectures given at the University of Washington College of Forestry on March 3, 4, and 5, 1960.

GORDON D. MARCKWORTH
Dean of the College of Forestry

THE GREELEY LECTURE SERIES

This is the fourth in a series of five lectures to be published by the University of Washington College of Forestry under a grant received in 1956 from the Industrial Forestry Association in memory of the late Colonel William B. Greeley. The following books have preceded this edition:

NUMBER ONE: *The Development of Industrial Forestry in the Pacific Northwest*
By Axel J. F. Brandstrom

Mr. Brandstrom was selected as the first Colonel William B. Greeley lecturer because of his pioneer work in industrial forestry in the Pacific Northwest, and his interest in it throughout the years.

NUMBER TWO: *History of Industrial Forestry in the South*
By Frank Heyward

The Southern Pine Region, with its tremendous development in industrial forestry during the past two decades, was chosen as the second area to be covered in this series. Because of his intimate relationship with southern industrial forestry during this period, Mr. Heyward was chosen as the second lecturer.

NUMBER THREE: *The Development of Industrial Forestry in the Northeast*
By Clarence S. Herr

The historical background of the Northeast Forest Region dates back to colonial times. Mr. Herr, an outstanding figure in industrial forestry throughout this area, was well chosen to lecture on this subject.

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The Development of Industrial Forestry in California

By EMANUEL FRITZ

Professor Emeritus, Forestry Department, University of California

PART I

HISTORICAL BACKGROUND

Every new undertaking has behind it a reason—a need or a pressure. This is true of industrial forestry in California. The reason for it is clear—the management of forests without impairment of their productiveness. For many years there was no real need for it, although it was always desirable. The State is only a little over a century old. For half its history it was difficult to prove a need; there was abundant land and forests and the population was small. But, as the years passed, a real need did develop, and industrial forestry was launched none too soon to prevent a state of urgency. There was pressure also, most of which came from conservationists as far back as the 1870's. The term conservationist, however, was not applied to the critics until later. The pressure became stronger with the years, and it unquestionably had some influence on the experimentation with forestry at the turn of the century. Very little came of it, perhaps mainly because of the lack of a stringency in timber supplies, the lack of practical knowledge of the application of forestry, and because the owners concerned had no understanding of it. That the critics had good cause did not help. They had little or nothing to prove their point. They had merely aligned their thinking and their expressions with those of the eastern United States where conditions were entirely different. As so often happens, a critic or an agitator has sound grounds but expends his efforts on broadcast criticism rather than on a constructive approach that would include cooperative trials of other methods. They weakened their cause because they made their living in other fields of endeavor, (where they themselves were not always innocent of improper practices) while the timber owners and operators lived with their problems day in and day out and felt they were doing all that the conditions permitted.

Timber famines, or at least local stringencies, were freely predicted in the eastern United States since the 1700's. They were still being predicted a quarter century ago. The famines never materialized. Periodically, the controversies over forest treatment became very bitter. All this created an atmosphere that precluded much confidence in the predictions on the part of lumbermen.

In California, where the real beginning of settlement dates from the Gold Rush in 1849, hardly twenty years went by before fears were expressed for a shortage of forests. This fear had a new and concomitant angle—a feeling that forest removal would reduce water supplies for irrigation. In a State, large parts of which are arid, water is always a critical resource and its availability is of real concern.

As the years went by the situation changed. More of the nation's lumber had to come from the West, local populations increased, methods of logging improved as new machines became available, more was learned about the

possibilities in consciously applied forestry principles, the ranks of the old individualists thinned, and an economic climate favorable to forestry began to develop.

Thus, the history of industrial forestry parallels, in California, its history elsewhere, European countries not excluded. Finally, industrial forestry emerged. It is not yet as widely practiced in California as in the Northwest or the Southeast, solely because the economic climate is not yet similarly favorable.

It does no good to recount failures of the past and what could have been done. Of a certainty every lumberman could have done certain simple things that would have cost little or nothing and would have left the land in productive condition, but here, also, we are inclined to forget what the ownership, operation, and market conditions were. Even our own forestry profession has changed its viewpoints as to methods. CHANGE, which is as certain as death and taxes, is an evidence of progress.

POPULATION GROWTH IN CALIFORNIA

In 1810 the population of California was under 10,000, not counting the aborigines. In 150 years it burst to 16,000,000, 50 per cent of which was added in the past 15 years. The first white settlers found 100,000,000 acres of a superabundance of every necessary resource, water, grass, rich soil, and timber. They could afford to use the resources lavishly; they did not have to be frugal. But man is a demanding animal. He is not satisfied with only the minimum requirements for food, clothing and shelter; he must have an abundance and a greater variety of each. He has added new demands—electric power, fast transport, and pleasures of every kind. He wants more of everything with less effort to get it. When he has invented a new device he immediately sets out to make it bigger, stronger, faster, cheaper, and fancier. There is no finality to man's craving for something new or better. To produce his new needs he has had to build reservoirs, power lines, smooth highways, large air fields, recreation areas, factories to make his automobiles and airplanes, paper mills for his packaging papers, and more sawmills for his lumber. As man builds, he may also destroy. The scenery that attracted him to the State, he clutters with his structures or makes unlovely with his operations, or hides behind billboards. He uses fire carelessly. He thinks his natural resources are inexhaustible and proceeds to use them lavishly and wastefully.

No creature, but man, has developed such a facility for changing his environment and for employing its resources for his multiple material needs and desires. Man's power to invent and "develop" seems to have outrun his ability to look ahead. But there always comes a time when he is forced to take a new look at what he has been doing. In anticipation of the time of reckoning and cognizant that a tree crop takes years to mature, a few leaders emerge and, after study and experimentation and taking action on their own lands, something is done. Others are disinterested or procrastinate until an emergency is upon them.

So it has been with the forests of California.

FOREST CUTTING RAISES FEARS

Timber cutting prior to the Gold Rush days (1849-50) made only a very slight dent in the forest. Most of the lumber, as well as the shingles and shakes, were split out by hand, or whip sawed. Even twenty years after the

Gold Rush, 1870, when population had risen to nearly half a million, and mechanization had started, lumber production was only about 350,000,000 bd. ft. This was a period of rapid agricultural and residential growth and the per capita lumber consumption was high because wood could be used lavishly. Lumber was supreme; it was abundant and cheap. It had almost no competitors in the building field.

To produce 350,000,000 bd. ft. in 1870 required the logging of less than 10,000 acres. Since the Gold Rush and to about 1870, less than 100,000 acres had been logged or picked over. This was far under 1 per cent of the State's total forest area of the time. Logging was concentrated in the more accessible localities—in the Lake Tahoe area near the mines of Nevada, on the Sierra Nevada's lower western slope where other miners were active, and along the coast tributary to harbors for water shipment to the San Francisco Bay Region. It was where it could be noted by travelers.

Californians even that early had developed a great love for the State and disliked seeing any part of it disturbed. John Muir, Starr King, and others were making their tours of the Sierra Nevada. Irrigationists were becoming alarmed over logging lest it would impair their water supplies. Farsighted citizens and nature lovers became concerned and, led by John Muir and others, clamored for parks; Yosemite was set aside and became the second oldest national park. Irrigationists began thinking of having all logging stopped. Both groups were, perhaps, more distraught over the manner of cutting and standards of utilization than of the acreage already cut. Yet, there were many more citizens who demanded development—more farms, more packing houses, more mines, more sawmills, and more people. How was the young State to become great, they asked, if its population and its farms and industries remained small and static.

CONSERVATION HAS AN EARLY START

So, in California, the year 1870 marks, roughly, the beginning of real alarm over forest resources and over forest practices that were considered to be wasteful and destructive to forest land productivity and water supplies. In 1875 the American Forestry Association was created and launched the conservation movement. In 1885 California created a State Board of Forestry, the first in the United States. Its functions were "to collect statistics and other information with regard to forestry . . . to act with a special view to the continuance of water resources that may be affected . . . by the destruction of forests . . ."¹

In 1892 the Board's statistician recommended the "establishment in the State University . . . of a Chair in Forestry . . . the principal duty of the professor filling it being . . . to go out as a missionary, an evangelist, among the people, for their enlightenment and their arousing to an appreciation of God's best gift to them—their magnificent forests—the sources, conservators, and restraining influence of the streams and the rivers, which make glad and fruitful the plains and the valleys of this wonderful State."² This quotation is given at some length to emphasize the concern for water and to show that the religious fervor that so strongly characterized forest conservation preaching in later years got an early start. Incidentally, we find in the same statistician's report one of the first recommendations, in the same terms used today, of "a wise and far-reaching policy of forest management."

¹ California State Board of Forestry, *Third Annual Report* for the years 1889-1890 (Sacramento: State Printer, 1890), p. 1.

² California State Board of Forestry, *Fourth Annual Report* for the years 1891-1892 (Sacramento: State Printer, 1892), p. 56.

That forest practices of the twenty years following the Gold Rush were "wasteful," cannot be denied. Stumpage and lumber were cheap, the supplies were abundant, the differential between the price of select and common grades of lumber was so narrow that the buyer spurned the grades that contained many knots and the lumberman had to leave the poorer logs in the woods. Only the best pine and redwood logs were taken to the mill. Certainly he could not mill and sell much lumber from the so-called inferior species, such as white fir. There would have been less waste if the consumer had been willing to use lower grades and he therefore must share the blame with the lumberman.

That the practices were "destructive" of productivity is not so clear. Many small trees were left, as were the "inferior" species. Logging advanced over the forest slowly and the areas cut each year were small. Nearby seed sources were plentiful. Ironically, the lands cut in this period in both the Pine and Redwood Regions, eventually produced, without man's help, some of the finest and densest stands of second growth in the United States. Today they are being logged and their prices bring tears to the eyes of old timers who sold their choicest old-growth stumpage for one-tenth as much. We can only hope that our present-day forestry can produce equally good stands.

LUMBER PRODUCTION

Lumber production continued to increase in volume, except for the Depression years, and, in 1956, reached a high of nearly 6 billion bd. ft. Oregon captured first place from Washington, and California moved into second place. Washington dropped to third.

Lumber production in California until 1940 was predominantly pine and redwood. World War II, the shrinking area of old growth, and the higher costs of manufacturing, greatly changed this situation. In the peak year 1956, for example, production was as follows:

	PERCENTAGE	
	1956*	1940†
Douglas fir	40.8	10.0
Redwood	18.4	19.9
Ponderosa pine	18.4	48.8
True firs	14.3	3.4
Sugar pine	5.8	15.0
Other species	2.3	2.9

* California [Pacific Southwest] Forest & Range Experiment Station, *Lumber Production in California in 1956* (Forest Survey Release No. 30, December, 1957).

† California [Pacific Southwest] Forest & Range Experiment Station, *A Century of Lumber Production in California and Nevada* (Forest Survey Release No. 20, June, 1953).

The high percentage of Douglas fir is due to the emergence of the Douglas fir area in northwestern California just east of the redwood belt, as a producing region. The output of this species, however, includes some that is intermingled in the redwood and pine regions.

Until about 1940, the Douglas fir area was considered so inaccessible that its volume at one time was not even included in the resource statistics. World War II caused many small loggers and mill men to look over the area and, finding it no more difficult to log than the Douglas fir areas they had previously logged in Oregon and Washington, and finding the stumpage dirt cheap, they

invaded the area in such numbers that soon the Douglas fir output exceeded that of the other species.

The War also brought the true firs into substantial market prominence. The pre-war high was 232,048,000 bd. ft. in 1925; in 1956 it was 841,798,000 bd. ft., a 360 per cent increase. In 1940 it was only 66,518,000 bd. ft. and accounted for only 3.4 per cent of the total. Generally they were cut sparingly or left standing or pulled down in the logging operations and left to rot, or, on national forest timber sales, where their cutting was mandatory, the logs were sometimes merely skidded off of government land on to private land and left there. This was cheaper than milling them and letting the lumber rot in the piles at the mills.

The record of California lumber production by years and species appears in the accompanying table:³

LUMBER PRODUCTION IN CALIFORNIA
(in thousands of board feet)

Year	Total	D. F.	Ponderosa	Redwood	Sugar pine	True fir
1869	353,842	30,000	204,000	75,000	35,000	n.d.
1899	737,760	18,264	285,841	360,167	52,108	n.d.
1910	1,265,876	103,169	409,117	543,493	101,561	66,120
1920	1,482,102	161,632	509,471	476,003	141,134	151,957
1925	2,042,991	206,325	785,967	489,941	299,456	232,048
1930	1,514,263	133,110	647,058	400,108	197,148	110,921
1935	1,355,713	95,508	679,543	328,862	161,230	61,016
1940	1,954,500	196,137	955,420	388,409	293,526	66,518
1945	2,260,792	372,885	914,880	443,806	194,532	285,638
1950	4,262,773	1,202,798	1,240,591	875,453	326,305	559,693
1956	5,880,041	2,403,513	1,080,061	1,079,544	341,200	841,798

Species not listed in the table and their cut for 1956, are: Incense cedar, 104,453M; Sitka spruce, 10,636M; Lodgepole pine, 5,293M; hemlock, 4,251M; Sierra redwood, 3,139M; Port Orford cedar, 2,043M; Digger pine, 2,013M; and several others, 2,097M.

Of the total 841,798M bd. ft. of true firs for 1956, Sierra white fir totaled 718,979M; red fir 69,760M, and coast grand fir 53,059M.

The 2,403,513M bd. ft. of Douglas fir reported for 1956 came, 578,795M from the Pine Region and 1,824,718M bd. ft. from northwestern California. This latter figure includes the Douglas fir mingled with and on the margins of the redwood belt, totaling perhaps a maximum of 200,000M bd. ft., leaving about 1,600,000M bd. ft. to have come from the newly opened Douglas fir area just east of the redwood belt. The above data are from Forest Survey Release No. 20.⁴

IMPACT OF WORLD WAR II

These data show how significantly California lumbering has changed in the past twenty years, particularly as to Douglas fir and true firs. The ability to sell the true firs has been a boon to the timberland owners and it has been a great aid to advancing industrial forestry. Anything that promotes closer utilization of the timber stands also helps industrial forestry.

³ California [Pacific Southwest] Forest & Range Experiment Station, *A Century of Lumber Production in California and Nevada* (Forest Survey Release No. 20, June, 1953).

⁴ California [Pacific Southwest] Forest & Range Experiment Station, *A Century of Lumber Production in California and Nevada* (Forest Survey Release No. 20, June, 1953).

The three-fold increase in lumber production between 1940 and 1956 required, of course, the establishment of more sawmills. It created a big change also in contract logging and log markets. These changes, in large part, were occasioned by (1) the ownership pattern of the forest areas not then owned by the older operating companies, (2) very cheap stumpage, and (3) by the increased logging on the national forests.

In 1940 there were about 80 sawmills in the Redwood Region and 220 in the California Pine Region. By 1948 these numbers had increased to 586 and 398, and by 1956 had dropped to 315 and 380, respectively. Obviously some mills were predicated on optimism—an expectation that another quarter section of timber would be available when the one purchased first had been cut. There were too many mills for the amount of timber available. Already the mortality that always follows a boom has had its effect, and it has not yet run its full course.

A new industry came into prominence following World War II. In 1940 California had only three important plywood plants. In 1956 it had about 40, most of them working on Douglas fir. They are important in this presentation because they, too, use logs and only the better ones.

Contract loggers, before 1940, were few. By 1955 there were 1,718 contract and company loggers according to the State Division of Forestry which is charged with registering all loggers. Of the 1,718 loggers probably 1,200 were contractors. Again this reflects the effect of the ownership pattern. In the Redwood-Douglas Fir Region alone 9,706 ownerships totaled 1,662,000 acres, whereas the 111 stable operators owned 1,231,000 acres.⁵

Before 1940 there was only a very modest general log market. Most of the lumber producers at that time were integrated from timber to final product, did their own logging and consumed the logs they produced. After 1940 and as the number of mills multiplied, many of the new mills owned no timber and relied on contract loggers for their log supplies.

The sudden increase in lumbering after 1940 was hailed gleefully by chambers of commerce and several towns were touted as the future lumber centers of the country. But, it gave industrial forestry, already well on its way, a temporary setback. In several limited sections it created havoc in the forest. This will be referred to again later.

Discounting the havoc created by the "fast buck" operators of the 1940-1950 era, the changes that hit California forests so suddenly, combined with the long stretch of prosperous business (the longest in the industry's history), the sudden realization that the end of the old growth is in sight, the pine industry's growing dependence on national forest stumpage, a renewed confidence in the future of wood, and the observation that others are making a go of marketing the heretofore spurned second growth, caused the industry to investigate more seriously the long-recommended practices that would assure permanence.

The interest was not at all new. It began nearly sixty years ago and was making significant progress when we were thrust into World War II. Several pine companies, already on a permanent basis, had set up their lands as tree farms in 1942. Two of the redwood operators had studies made of their forests by the U.S. Forest Service to determine some specific facts about selective cutting. A number of other California companies were on a selective cutting basis and were leaving their cutover lands in productive condition. The aston-

⁵ California [Pacific Southwest] Forest & Range Experiment Station, *Forest Statistics for the Redwood-Douglas Fir Subregion in California* (Forest Survey Release No. 19, January, 1953).

ishing success of the tree-farm program in intensifying the latent interest of others has been a continuing stimulus.

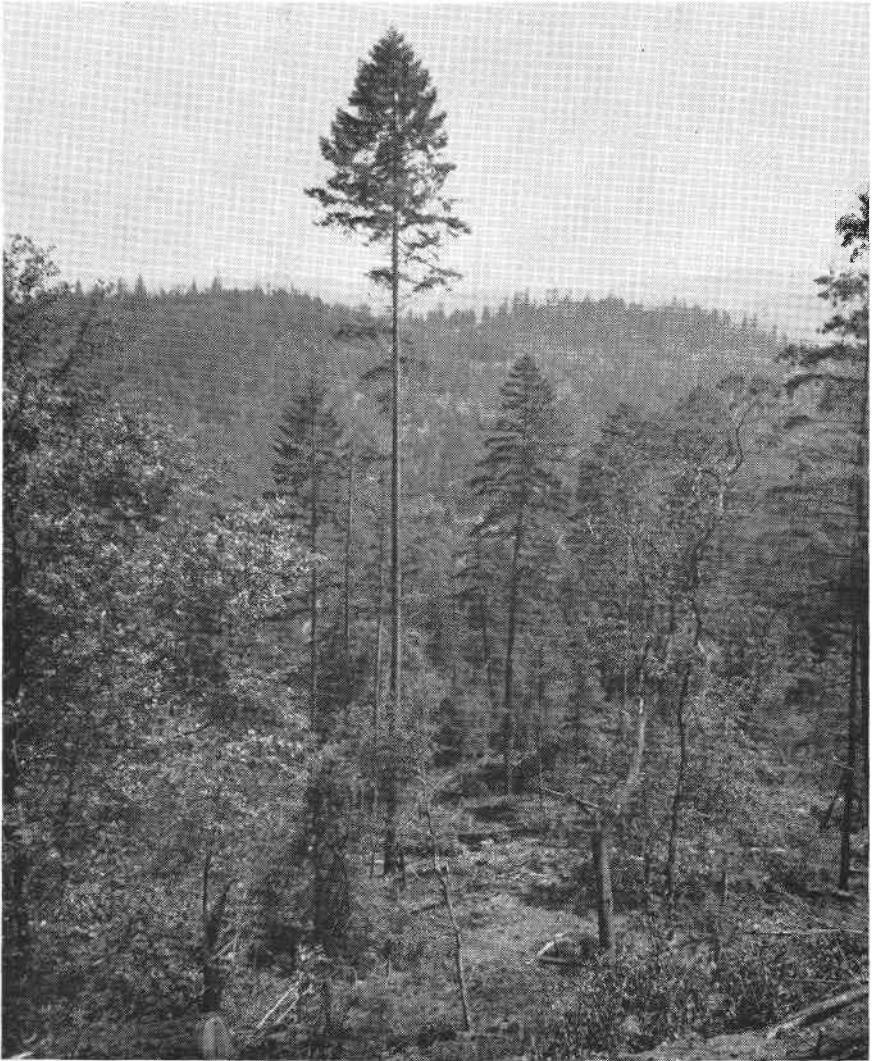
INDUSTRIAL FORESTRY HAS EMERGED

It would be seriously misleading to say that industrial forestry is universal today among forest owners in California. One must first define industrial forestry and judge how performances fit the definition.

Industrial forestry implies forest practices on privately-owned lands that will not impair the forest soil's ability to promptly replace what was cut with new trees of desirable species, to the end that lumbering can be made a profitable continuous enterprise. Industrial forestry is no different from public land forestry except as to its name and the basic fact that it must pay a profit commensurate with the risks taken and the effort put into it. In fact, industrial forestry, especially under its limitations of area, must be *better* than public forestry because it has risks and burdens that public forestry does not have to bear. More than 75 per cent of industrial operators in California's Pine and Redwood Regions qualify under the definition. Although some of these do not have specific plans for their own operating permanence, their lands are left in good condition and will be a future source of logs for general sale.

So far, formal industrial forestry in California is limited almost entirely to forest owner-operators who have large plant investments they wish to perpetuate. The fact that several large ownerships have not yet applied for tree farm certification does not mean they are not on an industrial forestry operating basis.

The acreage of the industrial forestry operations in the Redwood Region includes the bulk of the operating redwood forest land. In this Region 99 per cent of the commercial redwood is privately owned. In the Pine Region, the companies having large acreages are similarly on a permanent basis and have been practicing forestry for a longer period. Some of the pine companies own so little land that they must depend on national forest stumpage to achieve any permanence they may hope for. Nevertheless, in the main, they keep their own lands in a productive condition.



In the Douglas fir area, the southern extension of the Douglas Fir Region of Oregon, the stands are pure or mixed with hardwoods. Shown here is the Wagner property, near Garberville, cut selectively. The hardwoods, mostly tanbark oak, were left in anticipation of a future market.

PART 2

THE FOREST REGIONS OF CALIFORNIA

Let us now inquire into the technical aspects of forestry in California—the composition of the forests and the site factors that generate favorable or unfavorable tree-growing conditions and opportunities for industrial forestry.

THE STATE AS A WHOLE

California embraces a little over 100,000,000 acres and extends north and south for a thousand miles. Lengthwise of its middle is the great almost treeless Central Valley, 20 to 40 miles wide and 400 miles long and, in large part, an irrigated agricultural land. This great valley and the surrounding mountains—the Sierra Nevada on the east and the Coast Ranges on the west—make a relief map of the State look like an enormous elongated celery dish. Altitudes range from 280 ft. below sea level (Death Valley) to 14,500 ft. (Mt. Whitney). There are huge deserts and great prairies. Temperatures range from the oven-heat of the absolute desert to the arctic cold above timber line. Precipitation varies from one or two inches in southern California to more than 100 in. along the northern coast and on the higher mountains. In such a large area, spanning 10° of latitude, one should expect a tremendous variation in the vegetation—from nothing on some deserts to the beautiful pine forests of the Sierra Nevada and the lush redwood forest along the northern coast.

All but a small part of the commercial forest occurs in the northern half of the State. In the southern half, except for small areas in the higher mountains, the open land is mainly desert, grass or chaparral. Even in the northern half, large stretches of forest are separated by extensive areas of grass or chaparral.

Disregarding the scattered Digger pines, the light fringe forests and the widely scattered hardwoods, three distinct commercial forest areas can be recognized: the Pine Region, the redwood belt and the Douglas fir belt. For statistical purposes and because they form an economic and geographic unit, the U.S. Forest Service combines the redwood and Douglas fir belts and calls the combination the Redwood-Douglas Fir Region.

THE PINE REGION

This region rims the northern part of the Great Valley—on both slopes of the Sierra Nevada, across the jumbled Siskiyou Mountains to the inner Coast Range and thence southward to Lake County. There are large bodies of pure pine stands on the east side and in the northeastern corner of the State. Elsewhere it is mainly a region of mixed forests situated between 2,500 ft. and 7,500 ft., depending on latitude—ponderosa pine, sugar pine, Douglas fir, white fir, and incense cedar, with other species appearing at the lower and higher altitudes. The two principal pines reach magnificent form and the largest size of any pines in the world. Stands occasionally reach 100,000 bd. ft. per acre over relatively small areas. The average is much less, probably 20,000 to 25,000 bd. ft. per acre.

The forests are typically of the selection type, i.e., a mixture of all sizes, ages, and qualities. They are generally open enough to permit the natural establishment of new trees. Some botanists and foresters call them a "fire-type" of forest because fires, recurring for centuries, gave them a certain character



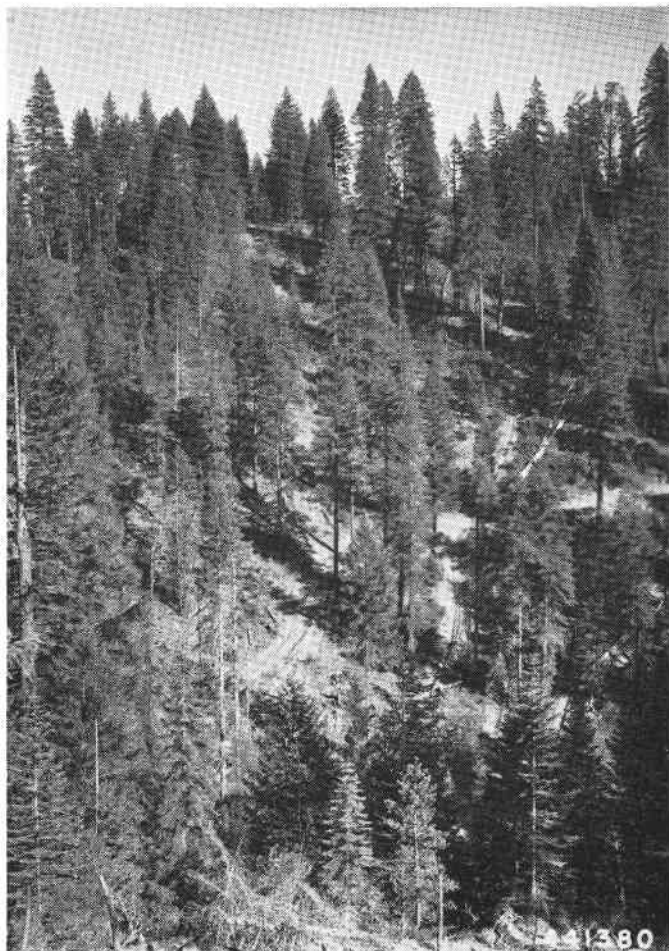
An early application (1935) of selective cutting in a mixed pine stand in Butte County, when the high-lead donkey-engine system was used for logging. Trees were saved almost to the donkey engine setting from which the photograph was made.

and probably account for the great size, high quality, and superb beauty of the trees that were spared.

This condition, or structure, of the forest, indicates that selective cutting is desirable from every viewpoint—silvicultural, and financial. It has been the universal method of cutting for many years. The modern tractor, as a logging machine, is better suited to this kind of logging than any other present-day mechanical system. Steam tractors for roading were used prior to World War I while the crawler-type tractor was born in Stockton and, immediately after that war was improved on pine operations for skidding.

Interest in cutting practices came early to the Pine Region. The Diamond Match Company (now Diamond National Corp.) is probably the first to make a serious attempt to find out how its extensive timberlands could be made a permanent source of logs for its mill. A preliminary fire protection and management plan was prepared in 1903 by E. A. Sterling of the old Bureau of Forestry, predecessor of the present U.S. Forest Service. (Sterling later became one of the first American consulting foresters.) The then president of the company, O. C. Barber, reported to his stockholders, "Your company holds a large pine forest in California which we hope can be made . . . perpetual."⁶ Note that he said "we hope." It is evidence that such management was something new and not certain of realization. It is evidence also that Mr. Barber did want to find out. A year later the company hired Harvey C. Stiles, apparently

⁶ W. H. Hutchinson, "The California Investment," a history of the Diamond Match Co. (mimeographed, 1957). Contains basic data for the printed condensation under title, *California Heritage* (published by Diamond Match Co., 1957).



Selective cutting on a National Forest Pine Region timber sale. Mature trees have been cut, leaving the smaller, younger trees of all species. Note tractor trail.

a horticulturist interested in forests, to carry the idea farther. He recommended selective cutting or, as he called it, "selective thinning." There were no tractors in those days. The high lead system, including "tight lining," was not well enough adapted to saving immature trees; furthermore the woods crews balked at making it adaptable. Nothing came of Barber's hope, but interest was continued in the company's central office in New York. In the late 1910's, W. A. Fairburn, successor to O. C. Barber as president, hired F. E. Olmsted, a Biltmore forestry graduate who had resigned as head of the California office of the U.S. Forest Service, to undertake installation of a management plan. In 1922 he, in turn, hired Richard A. Colgan, Jr., a Michigan State College forester, to help him acquire more timber inventory and other

data for planning and for educating the local manager and the woods crews. They had a difficult time. Job interest probably influenced the employees, particularly the fear that there might be an increase in the cost of logs, costs being the yardstick of managers and boards of directors for measuring the performance of logging departments. Furthermore, the company's California operations had difficulty in paying out. Olmsted died a few years later and Colgan, particularly when elevated to superintendent in 1928, continued the forestry effort with such skill, tact and persistence that finally woods practices were brought about that made the company's forest operations receive approbation from foresters in general, the state legislature, and conservation groups. For this, Colgan gives liberal credit to a new logging boss, Dana Bailey, whose cooperation and support he had won. Bailey discovered how the high-lead system could be adapted to selective cutting and got so interested that he took justifiable pride in the condition of the trees he left standing and, at the same time, lowering the logging costs. He also started a little nursery in his own garden and used the seedlings for planting small burns for which he felt his crews were responsible. But it was a constant struggle to keep the program alive, in spite of Colgan's and Bailey's interest and the obvious practicability of selective cutting. There was always someone higher up who was skeptical of the financial feasibility of forestry as applied to an industrial operation and when a difference of opinion arose, the New York office generally sided with the local management, in the interest of harmony. In the distant New York office and on the board of directors there was no one with any knowledge of forestry.

Now that the company has integrated its operations still further and has a large pulp mill to feed with raw material, it is difficult to see how its industrial forestry program can ever be abandoned. Such an integrated plant set-up requires a huge dollar investment; to safeguard such an investment requires an abundant and continuous supply of wood.

The Michigan-California Lumber Company at Camino, near Placerville, was the next pine company to take significant forward steps placing its operations on an industrial forestry basis. In 1924 it hired Swift Berry to explore the possibility of perfecting a cutting and logging system that would assure prompt regeneration on the cut areas. Company interest stemmed from its president, John W. Blodgett of Grand Rapids, Michigan, who directed the local manager to employ a forester. At about the same time, Vice-President Ray Danaher, with offices in San Francisco and a strong interest in the Western Forestry and Conservation Association, decided to support the Association in the plan of its manager, E. T. Allen, to set up a consulting service for its members. The Company thus became a client of the Association's forestry consulting department which was directed by Norman G. Jacobson. Swift Berry had extensive experience in timber sale management work in the U.S. Forest Service and several years as manager of the California Forest Protective Association. Berry and Jacobson worked together on a survey and study of the Company's forests. Jacobson came up with a report that confirmed the belief of Messrs. Blodgett and Danaher that the Company should adopt a policy of cutting its timber more conservatively. Mr. Berry later became manager and retired after 27 years with the Company. He is currently State Senator for his district and a staunch supporter of forestry legislation that removes some of the handicaps to more general adoption of forestry practices.

Industrial forestry on Michigan-California lands as developed by Swift Berry

and continued by his successors is a satisfying sight to behold and attracts many visitors.

From these two pioneer operations, industrial forestry spread to other companies—McCloud, Collins, Winton, Crane, Soper-Wheeler, Smith, and others. Richard Colgan continues it as manager of Shasta Forests, Inc.

At McCloud, Elmer E. Hall, as logging superintendent, early adopted selective cutting because he learned that many trees do not pay their way and had better be left standing. Furthermore, since white fir was unprofitable at the time, it was left standing and given protection against damage during logging for future harvest. Hall was not a forester but was regarded by those who knew of his work as one of the "forestry group." Were he living he would be quick to give credit to his superiors for supporting his stand, though it was he who worked out the methods in the woods.

Harold Crane, forestry trained and later the head of Crane Mills, was another of the pioneers to whom much credit is due for proving selective cutting in the Pine Region.

Rexford S. Black, a forestry graduate of University of Michigan, was another of the pioneers. In 1924 he followed Swift Berry as manager of the California Forest Protective Association. In that capacity it was his job to acquaint himself with the operations and forest management problems of the member companies. At the same time he had a keen personal interest in forestry, was an ardent supporter of the private enterprise system and determined to prove its worth in the woods. One of his first endeavors was the perfection of spark arresters for steam donkey engines and locomotives. He assisted in the passage and subsequent application of the Clarke-McNary cooperative fire law. As the industry's representative in Sacramento and later as chairman of the State Board of Forestry, he did much to educate legislators in forest problems and to solicit their support in the passage of legislation helpful for the promotion and application of forestry on private lands and the strengthening of the State Division of Forestry. As a forceful exponent of selective cutting he got a number of owners to give it a fair trial.

Incidentally, Black, Colgan, and Berry were a kind of informal committee that exchanged information and experience, set up experiments, and in general performed invaluable service as leaders in pine forestry, fire prevention, insect control, and, not the least, defending the private enterprise system during the days of socialistic pressures.

Although the foresters in private employ deserve consequential credit for spearheading forestry introduction in the Pine Region, they would insist on giving credit also to their superiors for giving them a chance to prove themselves and their ideas, and to the logging bosses and crews for their cooperation after their interest was aroused and won. Without such support they would have been helpless.

A number of other Pine Region foresters should be mentioned by more than name only, but time does not permit. Among them are Tom K. Oliver, Waller Reed, R. R. Chaffee, Clyde Martin, Walker Tilley, Lloyd Wambold, Richard Roseberry, and Stuart Moir. Martin, Moir, and Tilley, in that order, were foresters for the Western Pine Association, followed during World War II by Ernest Kolbe. The Association set up a forest practice committee, the meetings of which drew large attendances from company representatives to participate in the technical discussions. Wambold and Roseberry carried on for Diamond Match. Oliver, long a general manager, was in a position to help in policy

making. Chaffee, a Harvard forestry graduate and western representative of eastern owners, was distinctly successful in such administration of timber sales as would provide for reproduction. Reed initiated and conducts the excellent partial-cutting plan of Collins Pine Co. Since World War II, the numbers have been considerably augmented, some having already achieved positions of considerable responsibility.

It was not pleasant, during the 1920's and 1930's, for a young forester to enter private employ ("going over to the enemy" as it was called), knowing that he would have to endure the ridicule of many of his professional counterparts in public employ, not a few of whom were strongly inclined toward socialism. This situation is important to remember as a part of the history of the introduction of industrial forestry. It is now vastly improved and the foresters and their superiors have taken over the leadership.

THE REDWOOD BELT, OR REGION

This region as here described, is the area in which redwood is the characteristic and predominant tree species.⁷ Since the development of the adjoining Douglas fir forests it is now often referred to as the redwood "belt" to distinguish it from the Douglas fir area, or belt. More generally it is called merely "The Redwoods." As already stated, the two areas are combined and called Redwood-Douglas Fir Region by the Forest Survey of the U.S. Forest Service. This combination and nomenclature are unfortunate because they cause considerable confusion and mingle the statistics from the two quite different forest types.

The commercial redwood belt is a long north-and-south, irregular, broken strip, extending from Monterey Bay, south of San Francisco, north to just over the Oregon line. South of Monterey Bay and to the north edge of San Luis Obispo county, redwood is confined to the narrow canyon bottoms. The belt is about five hundred miles long but there are several gaps and the remainder varies in width from a few to from twenty to thirty miles. The easternmost redwood is about forty miles in a straight line from the sea.

It is often said that redwood occurs only in the fog belt, as if to say it "needs" fog. Actually it does not need fog, but the frequent fogs during the summers operate indirectly in that they conserve moisture by reducing transpiration from the leaves and arresting evaporation from the soil. Annual rainfall is from 40 in. to 100 in. Like the Pine Region, it receives an excess of precipitation in winter, more than 90 per cent of the annual total, but rarely receives snow; while in summer, rain is lacking or sparse. The dry period may extend, in some years, from June to December. April and May, critical months for the establishment of reproduction, may have a combined total of under 2 in. in occasional years. Thus the summer fogs are highly beneficial. The redwood belt is not at all the year-around wet region that it is generally believed to be. If it were, the forest would be an impenetrable jungle.

Topographically it has long, steep, often very rough, mountains, and many of the streams rising within it flow directly to the ocean. The Eel, Klamath, Smith, Van Dusen, and Mad Rivers and Redwood Creek rise well outside the Region. In Del Norte, Humboldt, and northern Mendocino Counties the belt is traversed by the famous Redwood Highway. In Marin, Sonoma, and southern Mendocino Counties this highway lies to the east of the redwoods.

The forest extends, in some places, from the edge of the ocean beach to the

⁷ *Western Conservation Journal*, Vol. XIV, No. 3 (Seattle; May-June, 1957). The entire issue is devoted to redwood resources, forest description, logging, milling, by-products, and parks.

tops of the two to three thousand-foot-high ridges. The heavier stands are generally at the lower elevations, but are found also on the slopes, and very large trees occasionally are found close to the ridge tops.

It is a comparatively small region. Originally it contained more than 1,500,000 acres of which about one-half remains uncut. Accurate data are not available. Forest Survey Release No. 25 gives 1,929,000 acres for the commercial area alone, and 1,111,000 acres for old growth.⁸

Because of the great size and age of some of the trees, the great volume per acre and the magnificence and superlative quality of the stands on some of the river benches, it has been under the public's critical eye for nearly a century. Logging methods during the steam donkey engine days, now happily passed, heaped much censure on the operators. Even foresters promoting the present selective cutting methods were not excluded from criticism for their association with cutting.

Coast redwood (*Sequoia sempervirens*), to distinguish it from its close biological, but geographically and altitudinally distant cousin, Sierra redwood (*Sequoia gigantea*), is the characteristic tree species, and occurs in completely pure stands and in mixed stands, the associates being Douglas fir and, to a lesser extent and depending on locality, lowland white fir, Sitka spruce, western hemlock, and occasionally Port Orford cedar and western red cedar. Hardwoods like tan-bark oak and chinquapin on the slopes, and alder on the moister lower slopes and canyon bottoms also may be present, sometimes abundant.

The forest is regarded as being of a climax order, i.e., able to continue its characteristic appearance when left in its natural condition. It is also, fortunately, a selection type of forest with a great spread of diameters, from saplings to giants of 16 ft., and ages from under one hundred to well over a thousand years. Heights vary with site factors and, on the best sites, reach a little more than 350 ft.

The mixed size and quality characteristic indicates that selective cutting is called for if the commercial forest is to be perpetuated.⁹ But the size and, particularly height and weight, of the trees, combined with rough terrain, introduce some unique difficulties in cutting and logging.

Earliest lumber manufacturing was by whip-sawing or by splitting, to which the fine and straight-grained specimen trees were admirably suited. Among the first lumbermen were the Russians who, in 1812, set up a fur station on the Sonoma County coast. When the sea otter was made almost extinct, they resorted to lumbering and made knock-down houses to be shipped to their stations in Alaska.

After the Gold Rush, cutting increased, and mills were established along the coast. Animals (oxen and horses) and jack screws were used to roll the big logs into the coastal streams and the logs were then "driven," in high water, to the mills. The pioneers cut only the best and most accessible trees and left the others. This was not a general practice but the results on lands so cut and logged offer our earliest proof that selective cutting is not only feasible but that it is also a sure way of regenerating the forest. Some of the finest second growth in the country, if not in the world, followed this old-style partial cutting and animal logging.¹⁰

⁸ California [Pacific Southwest] Forest & Range Experiment Station, *Forest Statistics for California* (Forest Survey Release No. 25).

⁹ *Western Conservation Journal*, Vol. XIV, No. 3 (Seattle: May-June, 1957). The entire issue is devoted to redwood resources, forest description, logging, milling, by-products, and parks.

¹⁰ Emanuel Fritz, *Characteristics, Utilization and Management of Second-Growth Redwood* (San Francisco: Foundation for American Resource Management, 1959).

The early attitude toward the perpetuation of redwood forests was unfavorable. It was believed that "redwood is a one-shot crop," and that "it takes a thousand years to grow a redwood." Some believed that redwood does not reproduce from seed, only from sprouts. Furthermore, it was believed the forest should be converted to pasture land. Even as late as 1944, a large land owner in the region, a sheep man and county board of supervisors' chairman, in reply to a question at a hearing before a legislative committee as to how redwood forests should be managed, said, to use his exact words, "I would cut it clean, burn hell out of it, and seed it to grass." His attitude reflected the belief of a large part of the local Redwood Region's population, but at the time he expressed it, it was dying out rapidly, in fact, he himself changed his attitude only a few months later. These beliefs and attitudes are important to remember when one studies the history of industrial forestry in the redwoods.

The twentieth century had hardly begun when a few leaders in the redwood industry began seriously to inquire into methods of perpetuating the forest, and what could be done with the cutover lands. As elsewhere, progress was slow, "by fits and starts," and determined in large part by business difficulties, the Depression of the 1930's, and by two great wars, as well as by the local concepts already mentioned.

The outstanding leader was C. R. Johnson, founder and president of the Union Lumber Company at Fort Bragg. He was not alone but he was unquestionably the leading light and had great influence on other operators. He initiated fire protection, experimentation with eucalyptus on the cutover land, the utilization of the local hardwoods for flooring, furniture, and other products. W. W. Peed, logging superintendent for Hammond Lumber Company and a trained engineer, was a leader in Humboldt County and did much experimenting in the 1920's on methods of logging and slash handling.

By the 1920's, "C. R." lead the principal operators into an extensive reforestation program. Included in this great program were the Union, Caspar, Mendocino, Albion, Pacific, Northern, Hammond, and Little River Lumber companies. The program, although killed by the Depression and the poor results on the plantations, caused the planting of 12 million seedlings grown in two large and several small company-operated nurseries. The area planted totalled 26,400 acres and the cost was nearly one-quarter million dollars. Admittedly, this program was, in part, an attempt to mitigate the ill effects of the clear cutting then practiced and to quiet public criticism. The logging machinery then available and the methods used were not conducive to the preservation of seed trees. Clear cutting, so different in its effect on the land, was a reversal of the early-day "bull team" logging that had begotten such excellent second growth. Clear cutting, over large areas, generated extensive brush fields.

The reforestation program was hailed far and wide for its size, the trained foresters executing it, and the companies that paid for it. It was the greatest American reforestation program ever attempted up to that time. But it came a cropper for several reasons: it was built on a weak foundation, it made too little provision for a method of cutting that would make planting unnecessary on lands still to be cut, and it was so new, that foresters themselves were groping in the dark. Among the foresters on the company payrolls to do the planting job were Willis G. Corbitt, Wm. H. Wirt, Virgil B. Davis, Carl O. Gerhardy, Wm. H. Gibbs, Guerdon Ellis, and Walker B. Tilley. All of these were also charged with fire prevention and suppression. Wm. R. Schofield was made forester for the Humboldt Redwood Reforestation Association and di-

rected some of the planting in Humboldt County. A. E. "Cap" Elam, timber cruiser for Little River, supervised the planting on that company's lands. In 1934 he became part-time field assistant for the California Redwood Association for instituting the selective cutting program under the N.R.A. Lumber Code. When the Depression set in and the program was terminated the foresters had to seek jobs elsewhere. This was a great loss because all of them were dedicated to their work and did the pioneering on nursery and field planting aided by the research work of Prof. Woodbridge Metcalf of the University of California. Tilley, however, in about 1946, returned to the redwoods as forester for the newly acquired forests of the Masonite Corporation. He is probably the most experienced redwood forester in private employ.

Article X of the Lumber Code, salvaged from the N.R.A. Code debacle of the Depression years, and the improvement of tractors to qualify them to handle large and very heavy logs, inaugurated the final great over-all change in cutting and logging methods, up to the present at least. While tractors had been experimented with in the redwoods as early as 1924, it was not until January, 1935, that they began to prove their worth. They have since proven themselves eminently successful and are responsible in a large measure, for effectuating the selective cutting program. For the first time since the abandonment of animals and the first light steam donkey engines, it was possible to leave immature trees well scattered over the cutover land. Selective cutting itself was not new but it now had a chance to be tried on a larger scale. It is now the universal method for cutting redwood stands. It must be admitted that some of the first selective cutting was solely incidental to the use of tractors, but it did emphasize to all that some trees do not pay their way and should be and could be left standing.

Concurrently, the selective cutting program was helped by a previous discovery that redwood is capable of greatly accelerating its growth rate when released from the competition of neighboring trees and thereupon no longer constrained to compete so severely for moisture and light. Of course, another factor was the redwood's remarkable ability to sprout profusely from the stumps.

Shortly after World War II set Europe afire, in 1939, Roy G. Wagner, then with the U.S. Forest Service and now forest and land manager for Masonite Corporation, was asked by Pacific and Union lumber companies to make a study of stand structures in relation to consciously applied selective cutting. Both reports gave irrefutable proof that selective cutting is financially a worthy undertaking, but by the time the studies were completed, the United States itself was thrust into the conflagration that had now become world wide, and the reports had to be temporarily shelved.

Immediately after the war, redwood companies were without foresters, but at present there are more than thirty trained foresters in private employ and doing purely forestry work. Selective cutting has been put on a marked-tree basis. It is no longer incidental to the use of tractors and it has led to further studies of the problems and possibilities of management for permanence without reducing current annual production.

In the redwood region it was a case of pioneering every step in a short period, much of the time by lone foresters. The old beliefs had to be corrected, the older young-growth stands had to be studied, the results of different methods of cutting and logging had to be observed and the methods evaluated, even the use of tractors had to be pioneered quickly. Early opposition to selec-

tive cutting by the woods crews themselves had to be overcome before the managements could proceed with plans for permanence. Today, it is safe to say that the bulk of the redwood forests is being logged in such a way that industrial forestry in its full sense has become a fact and that permanence of forest production is assured.

SAVING THE REDWOODS: PARKS¹¹

Although we are concerned here only with industrial forestry, a few words must be said about preserving some of the best stands for posterity. There is no tree growth so magnificent as a redwood forest elsewhere in the world. This was recognized by the founders of the Save-the-Redwoods League, and the owners agreed. For forty years the League has busied itself in raising money for purchasing the superlative stands along the Redwood Highway, mostly on a matching basis with the State. To date about seventy thousand acres of the very best have been acquired and turned over to the State for administration, and there are about thirty thousand acres more that should be acquired. Since the redwoods are climax forests, the world is assured forever of stands like those that, today, make us stand in awe, provided they continue to receive the protection they deserve.

THE DOUGLAS FIR REGION¹²

This region, as already stated, lies between the redwood belt and the inner Coast Range Pine Region, and has been under development only since about 1940. Its opening was brought on and its development was hastened by World War II. It is a region where Douglas fir is supreme and, ignoring the hardwoods, occurs in pure stands. Actually it is the southern extremity of the Douglas fir region of Oregon, but the forests are "spotty" and there are large areas of grass and brush lands.

Lumbering during World War II started from almost nothing to, in less than twenty years, more than one billion bd. ft. of production annually. It came too quickly and under stress of war conditions. Its quick rise, as to *numbers* of independent loggers and of sawmills, was due to the ownership pattern at the time. Aside from the stands in the Six Rivers National Forest, the only national forest in northwestern California, the timber was owned by large livestock ranchers and a host of small nonresident owners, generally families or individuals. Many of these owners inherited quarter sections from the original patentees, a result of the unwise application of the Homestead Act of 1862 and the Timber and Stone Act of 1878. These two laws harmed rather than helped an orderly development of western forests. Unfortunately there was no immediate reconsolidation into practicable operating units. Thus, in the California Douglas fir region, every ranch timber property and every quarter section of separate ownership invited a logger and a mill. Promoters and cruisers came in numbers and shortly there was indeed some reconsolidation, but it should have occurred forty years earlier.

The California Douglas Fir Region cannot yet be regarded as being in the industrial forestry fold on an extensive scale. Operations there began with the opening of World War II in Europe, and thus got under way in a small way in 1940 but boomed quickly as the United States entered the War. During

¹¹ *Western Conservation Journal*, Vol. XIV, No. 3 (Seattle: May-June, 1957). The entire issue is devoted to redwood resources, forest description, logging, milling, by-products, and parks.

¹² *Western Conservation Journal*, Vol. XIV, No. 3 (Seattle: May-June, 1957). The entire issue is devoted to redwood resources, forest description, logging, milling, by-products, and parks.

the hectic, disordered, "fast buck" war and immediate post-war years old-time exploitation was the order. Industrial forestry progress dates from about 1950 and can be credited almost wholly to livestock ranchers owning large areas of timber.

How these ranchers got interested makes a good story, because it exemplifies several problems that have handicapped good forest land management.¹³ Briefly, the ranchers, some of them very large owners, tried for years to convert their forest land to grass by girdling, slashing, or burning. The trees were of no value to them or to anyone else prior to 1940. The tax assessors themselves held this view and gave the timber no assessed valuation or only a nominal one. To the ranchers their forests were a hindrance. When World War II started, lumber came into great demand and surplus loggers came down from Oregon and Washington to look at the timber. They liked what they saw, particularly the price, often only one or two dollars per M. The ranchers eagerly embraced the loggers. Getting paid to have their own land cleared was too good to be true! Such a rush of loggers, land lookers, cruisers, and promoters got under way as to make observers think of the stampede of land applicants to the Cherokee strip a hundred years ago. Competition upped the stumpage prices steadily and the ranchers, appraising the changed situation, decided they had been giving away something of real value. Not only that, the smart ones compared the dollar yield of stumpage with that of sheep and cattle and found their timber to be a richer lode than their live stock. One rancher put it this way: "Every time I see a truck load of logs leave my ranch I compare its value to a truck load of livestock and I find the logs pay better and are much less trouble." He regarded himself thereafter as a combination tree farmer and cattle rancher. Unfortunately for the ranchers, some had signed long-term logging contracts that prevented them from reaping the full benefits of their timber sales and they were powerless to change the methods of the loggers. The contracts made no provision for continuous timber growing. There is more to this story, but time does not permit telling it. Suffice to say, the ranchers of Humboldt County are quite timber-value minded and have initiated steps through their farm adviser, W. D. Pine, for better contracts and better supervision. The experience of the ranchers seemed worthy of mention at some length because it is such an important part of the forest history in one part of the State. Incidentally, "Doug" Pine was given the 1959 award of the American Forestry Association for awakening ranchers to the wisdom of handling their forested areas as timber-crop land instead of attempting to convert it to pasturage.

Fortunately the hectic war-time and immediate post-war periods are over. The Douglas fir industry, in northwestern California, is settling down. More and more ranch owners are becoming as much interested in tree farming as in livestock raising; the smaller properties are being consolidated and are drifting into stronger hands; the excessive number of independent, or "gyppo," loggers and "peckerwood" sawmills has already dropped off 20 per cent and more, and more thought is being given to the regeneration of the cutover lands. Industrial forestry has made a start and it appears to be on the threshold of extension.

¹³ *Western Conservation Journal*, Vol. XIV, No. 3 (Seattle: May-June, 1957). The entire issue is devoted to redwood resources, forest description, logging, milling, by-products, and parks.



Selective cutting in a mixed stand of pine and white fir in Pine Region on a National Forest. The pines have been cut and the fir left—a situation prevailing before fir became marketable on a profitable scale.

PART 3

PROBLEMS AND AIDS

There are several factors that present serious problems to those owners who are perfecting their operations for the eventual full realization of their plans for permanent operations. In large part they are common to all forested portions of California. There are also several "movements" that are facilitating the realization of permanence. These unfavorable factors and the several helpful activities will now be given brief explanation.

CLIMATIC FACTORS

The so-called salubrious climate of California, so highly beneficial once re-production is firmly established, does not live up to its reputation when it comes to initiating natural and artificial reforestation. The summers are very dry for from four to six months. In some years natural seedlings appear in abundance while the earth is still moist, only to be killed by long dry periods aggravated by the even more critical spells of "fire weather" in late summer and early fall. It is a fortunate seedling that has begun life on a particularly propitious spot. Most of them are not so lucky.

The unfavorable weather situation has stalled attempts at large-scale reforestation of idle or partially idle forest lands. These lands total about 4,000,000 acres in the Pine and Redwood Regions, and are the result of past fires and clear cutting before the tractor came into the woods. The U.S. Forest Service, the State Division of Forestry, and private owners are experimenting in the hope of finding methods of seeding or planting that not only reduce the high mortality in plantations and among natural seedlings caused by our dry summers, but are also of a cost that is justifiable.

Many of the idle or partly idle acres are heavily covered with brush species. How this brush can be removed or rendered ineffectual to reforestation poses a very difficult problem to the forester charged with the job of restoring forest growth, its cost being the principal hurdle to clear. The idle forest land problem was made a special study by the Commonwealth Club of California.¹⁴ The Club's printed report of 1959 declared it a problem that requires early action. Concurrently, the California State Legislature authorized the State Forester to assign a technical man to the job of collecting and collating all available information and to assist in coordinating the experimentation of various agencies and private owners. It is expected that, when effective methods of assuring high survivals in plantations are found and their costs are reasonable, a large-scale reforestation program will be initiated by owners.

On lands that have been cut selectively, the problem of regeneration is not so severe. The residual stand provides the seed and some protection against soil desiccation. Nevertheless, the realization of a good stand of new seedlings is so slow that some company foresters are considering under-planting to reduce the costly time element.

INSECTS AND DISEASE DAMAGE

Insects have been a serious problem in the Pine Region and have been charged with four times the damage done by fire. Men like John Miller, Paul

¹⁴ Commonwealth Club of California, "Reforestation of California's Idle Cutover Lands." Report of Forest and Recreation Section, *The Commonwealth*, Vol. 35, No. 26 (San Francisco: June 29, 1959).

Keen, and Ralph Hall, who made notable contributions to insect control methods, at the same time helped win converts to industrial forestry by their wholly professional approach and friendly cooperation.

Blister rust is the principal tree killing disease and appears to limit the future commercial production of sugar pine to restricted areas, where the expense of controlling the disease can be justified by the value of the product.

In the coastal area there are no tree-killing diseases or insects on redwood.

In the Douglas fir forests there has been no insect or disease problem until very recently when insects were found to be attacking young trees, though not in alarming volume.

ANIMAL DAMAGE

Reforestation-damage by animals is severe in California. Once regarded as of purely biological interest it is now accepted for what it is—a serious handicap to any form of reforestation. Mice and birds devour the seeds; rabbits nibble off or girdle seedlings; when the stems are an inch or more in diameter porcupines girdle them row by row; on large sapling-stage trees, squirrels and porcupines compound the girdling; deer browse on some species and prune large seedlings like a skilled topiarist; if the tree succeeds in reaching twenty-five years the black bear takes his toll. No part of the forested areas is free from these losses. Porcupines, however, are not known inside the redwood forest but the black bear seems to have picked the redwoods and intermingled Douglas firs as his special meat in spring time. The problem of the forester is to keep these attacks and losses at a sufferable minimum. It is discouraging to have a plantation so severely damaged that it must be replanted. At \$50 per acre for the initial planting, it is obvious that, unless animal damage can be controlled, reforestation will never become a fact on the scale on which it is needed in this State. It is ironical that some conservationists, after dozens of years of clamoring for reforestation, now obstruct it by opposing animal control.

FIRE

While California has had no forest fires of the vast extent of the Tillamook fire in Oregon or the 1910 fires in Idaho, there have been too many of twenty thousand to forty thousand acres. The long dry summers, aggravated by the severe "fire weather" of the late summer and early autumn months, are conducive to rapid spread. Selection forests, like those of our Redwood and Pine Regions, have broken and irregular crown canopies and are therefore not likely to support crown fires like those in the Pacific Northwest, but the dry litter and inflammable lower story of shrubs contributes to rapid spread. As more even-aged forests are established it can be expected that the fire situation will be worsened. Fire protection is a job that can never be slighted. There are always new people to educate and new hazards to meet. Even then there may be a wild fire such as those of recent years.

Until the late 1930's many Californians—lumbermen and laymen alike—believed that the forest should be burned over at intervals to remove low ground cover and litter, thus to prevent catastrophic wild fires. This was more true in the Pine than in the Redwood Region, although in the latter fires have burned in some part of the forest several times each century. Exemplifying the different fire conditions in the Redwood Region is the handling of logging slash. It used to be the practice to burn slash broadcast. Most of these fires would go out when they penetrated the shady old-growth. But sometimes they did go

through the old growth for miles as they did in 1936; the redwood trees survived, though damaged. Nevertheless, under present-day conditions, with some slash left for soil protection, or which, if burned, would damage the residual stand, fire protection has had to be intensified. Before 1936 little attention was paid to fire in the Redwood Region and even state laws exempted the redwoods from certain control measures required in the Pine Region.

In the Pine Region Dick Colgan was the first to have a permanent fire fighting crew. In 1927, convinced that his forestry efforts would be of no avail if forest fires were not given more attention, he organized the North Butte (County) Protective Association which continued until the late 1940's when the State took over fire protection. He was also one of the first to undertake snag disposal until, in 1935, he had it on a 100 per cent basis.

In the 1920's there was a great controversy in the Pine Region between foresters and timber owners over light burning. Private owners argued for frequent light burning. They feared wild fires that were so difficult to control. This light burning theory still bobs up occasionally. This present year, in fact, several legislators, looking at the annual state fire control costs, are asking if it would not be cheaper to burn "lightly" and frequently. Obviously, what fires do, aside from consuming unwanted shrubs or offal from the trees, is not understood by them. Light burning itself, is not cheap, when properly done. It might have a place under certain special conditions and if organized and directed by skilled, watchful men equipped with substantial data on fire weather conditions. It is dangerous in the hands of unskilled men and without such data.

KEEP GREEN PROGRAMS

Like the Tree Farm program the Keep Green program has been an invaluable educational aid to the practice of industrial forestry. Since about one-half of the present population of California has come rather recently from states in which fire hazards, fire weather conditions, rates of spread, and difficulties of suppression are not as rigorous as here, the program is very necessary to warn the newcomers of our fire conditions.

TREE FARM PROGRAM

The Tree Farm program was initiated at an opportune time. The Pine Region joined it soon after its start in 1941 in Washington State. The Redwood Region adopted it in 1950.

Although ridiculed at first as window dressing, it went forward steadily even during the War years. As an instrumentality for educating the general public in the problems of industrial forestry and the relation of the average citizen to its practice, it has been an unparalleled success in the general field of conservation education. Furthermore, it has stimulated interest among those large and small timberland owners who previously had given forestry little serious thought. It has been successful mainly because it was soundly conceived, intelligently promoted and because of the examples set by respected leaders. The tree farm certificate and sign have become hallmarks of good forest management and, like the *Good Housekeeping* magazine's certificate of merit, they inspire interest, care, and confidence.

Tree farms in California, in the Pine Region, now number 222 with an area of 2,116,960 acres; in the Redwood Region they number 105 units with an area of 590,591 acres. Several owners have elected not to be certified as tree

farmers even though their standards of management would fully qualify them for certification.

SELECTIVE CUTTING

Selective cutting is practically universal in the Pine and Redwood Regions. In the Douglas fir area both clear cutting and selective cutting are practiced, the former with high lead logging equipment. Selective cutting has silvicultural, economic, and aesthetic implications.

Silviculturally it provides for leaving a number of seed and immature trees. These trees, besides casting seed for reforesting the openings left by logging, also provide shade to reduce soil desiccation and, consequently, the mortality of natural seedlings is reduced. The "leave" trees themselves form a nucleus for an early second cutting.

Economically, the leave trees, or residual stand, provide for a continuation of the production of high quality lumber, the like of which is hardly possible on comparatively short plantation rotations. Thus, there is an attractive financial aspect to this method of cutting. However, selective cutting requires better supervision than clear cutting, first, for the designation of trees to be cut or to be left; second, for preventing felling and logging damage, and, third, to prevent damage by fires that may be set to dispose of heavy accumulations of slash. Fire prevention has become imperative if one wants to reap the full benefits of selective cutting.

Selective cutting is practicable only in stands of mixed size and age classes and for species that are sufficiently windfirm to prevent blowing down after their greater exposure to strong winds. In the Douglas fir forests it must be applied with caution and due regard to the density of the stands.

Aesthetically, selective cutting leaves the cutover land in a more presentable condition. After a few years of natural regeneration a selectively logged stand looks like an originally light stand to the untrained eye.

SECOND GROWTH

Where second growth is owned in relatively small areas by nonoperating owners it is being cut or likely soon to be cut. On the other hand, owners that are set up for permanent lumbering hold their second growth in reserve until after they have completed their first round cutting through the old growth. Some are experimenting with stand improvement cuttings to maintain volume increment and to stimulate quality growth. Such improvement cuttings, on a full scale are recommended only when and where there is a market for the material cut.¹⁵ Industrial foresters hopefully look forward to a larger pulpwood market so they can give these stands the improvement thinning they have long needed. Present forest taxation laws, particularly the interpretation of the reforestation law, are a present deterrent for such cuttings. A mere improvement cutting causes some assessors to apply the ad valorem tax system. The amendment of this law has been under discussion and study for several years.

COLLATERAL AGENCIES

Several agencies, supported by private industry, have been of great aid in developing a public understanding of industrial forestry. First there is the California Forest Protective Association founded in 1909 and covering all the local forest regions. It has been a powerful factor in winning legislative under-

¹⁵ Emanuel Fritz, *Characteristics, Utilization and Management of Second-Growth Redwood* (San Francisco: Foundation for American Resource Management, 1959).

standing. Then there are the Tree Farm and the Keep Green programs, and the Sierra-Cascade Logging Conference in the Pine Region and the Redwood Region Logging Conference in the Redwood Region. The RRLC, founded in 1936, is the oldest of the western regional logging conferences supplementing the over-all Pacific Logging Congress. These conferences are directed in large part toward a fuller understanding of forestry methods and their application on the part of the woods personnel.

In the Redwood Region the above are augmented by the Redwood Region Conservation Council and its own several programs.¹⁶ It administers the Keep the Redwood Region Green program and has several committees for special subjects like education and fire protection. It obtains more direct local interest through "Redwood Circles" which meet to discuss the broader local forest problems. While it aims at public understanding it also helps train those high school students who will step directly from school into industry jobs. This is accomplished by encouraging the local high schools to install vocational courses in forestry and lumbering.¹⁷ To date, eight high schools of the Redwood Region give such courses. Furthermore, it takes 100 of the top students on a four-day field conference. This Junior Logging Conference has been eminently successful. The boys come in school busses from their several schools to the beautiful state-owned Mendocino Woodlands camps in Jackson State Forest and are given tastes of forestry methods, cruising, log scaling, logging, milling, and fire protection. About fifty adults from industry and public service attend with the students, contributing time, equipment and money; giving lectures and field demonstrations; mingling with the students and discussing their problems in off hours.

In Humboldt County, where the lumber industry pays one-fifth of the annual total tax bill of \$10.5 million, there has been set up what is probably the first county forestry department dealing directly with owners like a county farm extension specialist.¹⁸ In an advisory capacity there is also a county forestry committee of 17 citizens all from professional or business pursuits. This committee meets monthly, works on policy matters and advises the County Board of Supervisors. The County Forester is a trained forester and serves as secretary of the County Forestry Committee.

Public agencies, of course, play an important part in forestry matters. Some of their members take an active part in the meetings of the logging conferences and the Redwood Region Conservation Council. The State Division of Forestry is responsible for state-wide fire protection; the administration of the State Forest Practices Act; and for management of the 75,000 acres of State forests, the largest, 50,000 acres, being in the redwood belt. The U.S. Forest Service does experimental work in reforestation; the Pacific Southwest Forest Experiment Station performs some of the research of value to industrial foresters, and the University of California School of Forestry conducts an annual management school as well as research; the State Department of Education supports the RRCC's educational programs and encourages the teaching of conservation generally, and forestry and lumbering on a vocational level in the Redwood Region high schools; the U.S. Fish and Wildlife Service conducts studies on animal damage control.

¹⁶ *Western Conservation Journal*, Vol. XIV, No. 3 (Seattle: May-June, 1957). The entire issue is devoted to redwood resources, forest description, logging, milling, by-products, and parks.

¹⁷ *Western Conservation Journal*, Vol. XIV, No. 3 (Seattle: May-June, 1957). The entire issue is devoted to redwood resources, forest description, logging, milling, by-products, and parks.

¹⁸ Redwood Region Logging Conference. Proceedings, 20th Annual Meeting and Equipment Show, May 23-24, 1958, Eureka, California.

PART 4

LOGGERS, MACHINES, AND FORESTERS

Industrial forestry is a specialty like logging. Each requires men with special aptitudes and skills. The logger and the forester have not always seen eye to eye. In the past the logger, often impelled by job interest, has resented the intrusion of the forester and, in some cases, the forester lacked the tact to deal with the woods personnel. Along with his pioneering spirit, resourcefulness, ability to improvise and invent, the logger in California as elsewhere also has been peculiarly individualistic and independent, but once he caught the spirit of industrial forestry he became an invaluable aid and supporter, especially in practicalizing the forester's suggestions.

The boss logger is very much a key man in any forestry operation. It has been well expressed on the program of the 1958 Redwood Region Logging Conference.¹⁹ The theme of the meeting was "The Logger—Key Man for Closer Utilization and Permanence." Expanding on this slogan the program stated:

Permanence is a matter of men and machines and how they are used, as well as of forestry cutting practices. Once a policy of managing remaining stands of old growth for permanence is set up, its success depends on how the timber is logged and how the cutover land looks.

The logger can either make or break the hope for permanence. The company approves certain cutting and protection practices, but the logger plans the logging operation and selects the men and machines to do the job. He must get the logs out at lowest cost and with the least loss of volume. How the job is done determines how soon a full crop of new trees is established. Any avoidable damage to residual trees, and poor utilization, detracts from the possibility of permanent timber production and plant operation. Whatever the logger does leaves a long-term mark on the woods. It may be good for permanence or it may be very bad and may require many years to rectify. Permanence requires every acre to produce its potential maximum without loss of years of growth.

Thus the logger, more than the forester, is the key man for effectuating the company's plan for permanence, and for extending the life of the old growth stands.

Some foresters criticized this statement, at the time. But note that it makes the logger the man who *effectuates* a plan for industrial forestry. The forester prepares the plan but the logger has to *carry out* the logging.

It is not enough for the board of directors and the local management to want to break into industrial forestry. They must have the willing, interested and cooperative support of the woods personnel. They have to install a trained forester, of course, and in his selection the tactfulness of the candidate must be given as much consideration as his imagination, initiative, training, and skill. Management must give direct orders to the logging superintendent to give sympathetic support to the forester, and the forester must learn as quickly as he can the many problems of the logger, not the least of which is the cost of the logs, the yardstick by which the logger's work is measured. Once a congenial relationship has been established between logger and forester it follows,

¹⁹ Redwood Region Logging Conference. Proceedings, 20th Annual Meeting and Equipment Show, May 23-24, 1958, Eureka, California.



A mixed pine stand in Calaveras County cut selectively in 1960 and logged with tractors. The original volume of 50,000 bd. ft. per acre was cut to a 22-inch diameter limit, leaving 6,000 bd. ft. per acre.

almost without fail, that the logger and forester bring ideas to one another and become of mutual help.

Were there no lumbering there would be no need for industrial foresters. Lumbering therefore begets the need for forestry and foresters. A forestry department is as essential as the logging, milling, and sales departments and should have equal status when continuous operation is a company's policy.

Since the board of directors is the approving agency, a company would be well advised to have as one of the board's members a man trained in forestry, or at least one acquainted with its aims and methods and the financial aspects of forestry operations.

PART 5

THE INEVITABILITY OF CHANGE

Industrial forestry is not yet so widespread nor so well organized in California as in the Northwest and the Southeast, even though it got an earlier start here. The situation was quite different.

Although population has been increasing rapidly since the close of the first World War, it did not have much impact on the forests of the State until during and after World War II.

The State had a large reserve of privately owned forests. Therefore there was no readily apparent stringency as to supplies. The economic climate was not favorable. There were no pulp mills until after 1945 to improve utilization standards. The State depended for its general building lumber pretty largely on the mills of Oregon and Washington, as it has for a hundred years. Transportation was mostly by coastwise lumber vessels. There was even a sawmill in San Diego until about 1943 that received its logs in huge rafts from Columbia River points. The two pines of the Sierra Nevada and the redwood of the coast were used mainly for specialty purposes, including interior trim, siding, and industrial lumber. The Douglas fir mingled with the pines and redwood was only lightly used and, in some areas, local building codes opposed the use of Sierra Nevada Douglas fir for framing. The inner Coast Range forests had been only barely touched.

But CHANGE, as always, was working inexorably. It would have come even without World War II, although it would have taken a more leisurely course and without causing drastic dislocations. Industrial forestry came only after years of economic change.

In the Northwest another factor was different than in California. Lumbering in the Northwest was already a huge and dominant industry even before 1920, while in California it was widely scattered, away from the principal cities, and far from being a dominant industry except locally. One effect was that many more forestry graduates sought and obtained jobs in the logging and manufacturing departments of northwestern lumber companies, and a significant number of them advanced to positions of responsibility in which they had influence on forest management policies. In California, on the other hand, relatively few foresters sought such employment and fewer achieved positions of influence. It is significant, however, that these few exercised a profound influence on the trial and final adoption of industrial forestry by their employers.

What has happened in California is thus merely one more example of the impact of CHANGE and of its timing and rate. It is an example also of the influence of interested men. We have had some men in the logging departments who were effective roadblocks, and others who were equally effective in giving industrial forestry a strong boost. That is probably not a peculiarity of the lumber industry. We find this situation true in all walks of life—business and professional, and in public and private enterprises.

In the final analysis of the prologue to California industrial forestry, it must be agreed that economic conditions that affected timber management were slower in developing than elsewhere. But its emergence on a large scale was inevitable.

At present it is safe to say that in our Pine and Redwood Regions 75 per cent

of the current logging is done in such a way that productivity of the forest land is not impaired and that it exceeds by a wide margin the requirements of the State Forest Practices Law. A very large part of this 75 per cent is according to programs designed for continuous operation and ultimate permanence with little or no change in the present annual plant production.

World War II brought to California forestry both distress and progress—distress in the too quickly developed Douglas fir area in the northwestern counties and in a small part of the pine and redwood areas, and accelerated progress in the older pine and redwood operating areas. Most of the distressing logging practices, as already indicated, were due in large part to the ownership pattern, the many small ownerships pressing for a financial return. These properties invited operations by a considerable number of inexperienced, disinterested, temporary loggers. Many of the small mills, about seven hundred new ones since 1940, were equally temporary, poorly equipped and financed, and poorly operated.

Observation of the treatment of these forests lands is convincing evidence that forests should be owned in complete watershed units, preferably in acreages sufficiently large to permit a logical, long-term logging plan, full integration, and better manufacturing facilities and stronger financing. This is not a new situation. It has been a problem ever since lumbering became a large-scale industry in the United States.²⁰

Progress of man, and of his works has always been positive. It was not always uniformly positive. There were setbacks, such as those just mentioned, but they are not permanent. Resumption of progress may be slow, but it does occur. At times it may be rapid, as in the past fifteen years.

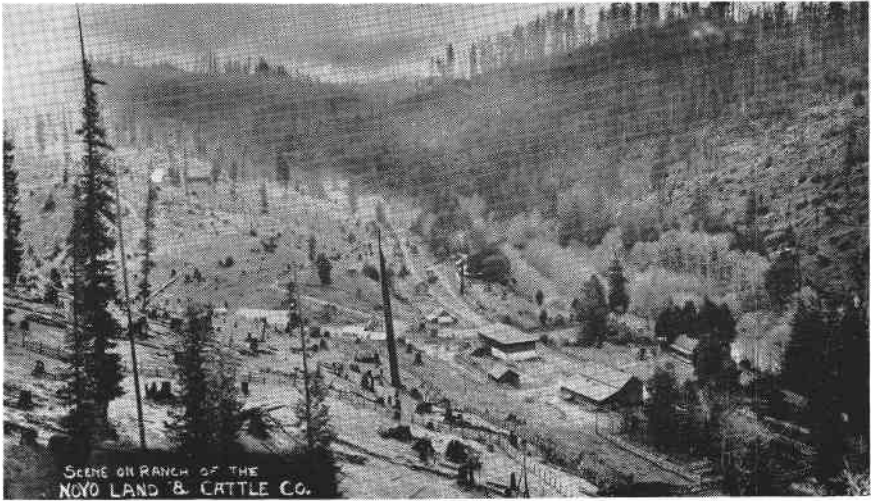
During the Depression years, a lecturer speaking on the development of civilization was asked, "Doesn't this Depression mark the end of civilization?" He replied emphatically, "No, it does not. Man has always progressed. He may stumble now and then, even fall flat on his face, but he always gets up and moves forward."

So it has been with industrial forestry in California. It has been brought on, with temporary setbacks and slowdowns, by the processes that cause CHANGE. The restless human mind seems never to be satisfied with the status quo. When man's curiosity has discovered a new principle he sets out to put it to use. When economic situations change, he adjusts to them. When timber was over-abundant and prices low, forest practices were influenced negatively. When cutover acreages became noticeable, some owners began to wonder what to do with them. When old-growth supplies showed marked signs of dwindling, they became interested in making them continuous. Thus, we entered into an era of industrial forestry. Great progress has been made and it is irreversible. While we can be proud of the industrial forestry we now have, we will look back upon it in future years as having been crude.

When we speak of the industrial forestry of today we have to generalize. There will always be some skeptics, some poor operators, but there also always will be more progressive ones, those who set the pace, set the standards and lead the majority. It is no different than in agriculture where we have good farmers and poor farmers. When we find skepticism and ridicule they need not be allowed to excite or depress us. Ignoring them renders them incapable of harm.

Critics of industrial forestry practices are inclined to look backward and to

²⁰ J. Wilcox Brown, *Forest History of Mount Moosilauke* (Appalachia, December, 1958).



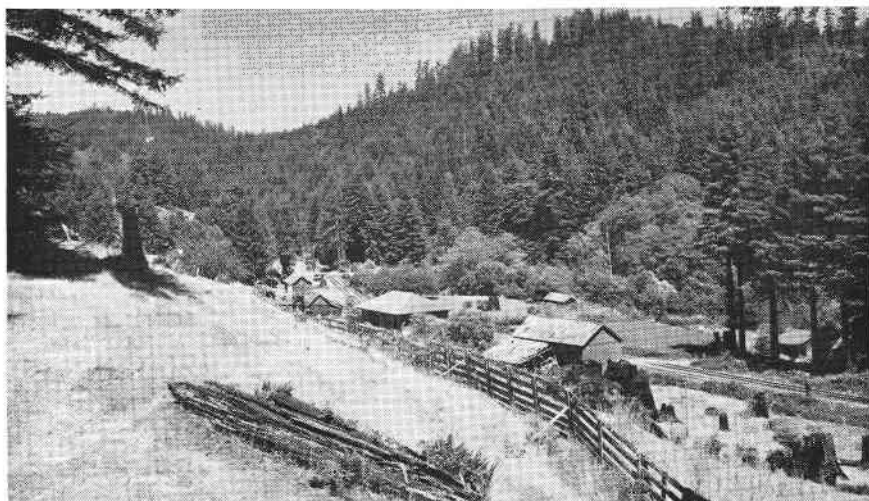
BEFORE

View of a redwood area, photographed in 1905, showing three kinds of land management. In the foreground, the clearing was complete and grass was sown to make a cattle ranch. In the center background where bull teams or light machinery were used for skidding, a number of the smaller trees were left standing. In the extreme right background, the cutting was heavier and very few seed trees were left. The dark spots at the right are stump-sprout clumps, indicating cutting a year or two before.

overlook changes. They cite, with complete justification, that some minimum practices could have been followed to prevent the debasement of cutover lands. Examined closely, however, we find that since all people and all conditions are not alike, results vary. Thus we find that some lands have been relegated to idleness and others were caused to retain their productivity. Even a small forest property can be so managed that its future productivity is not impaired. This is the essence of continuous operation even if financial returns come only at wide intervals. We have an excellent example in Joy Woods Tree Farm, in Sonoma County, of a continuously productive property of only 700 acres of woods, owned until the past year in a single family, operated on and off for 92 years, and always logged in a manner that preserved the young growing stock. It was considered good business. The owners knew nothing about forestry but they apparently did know that small trees don't stay small and therefore, if preserved, would make sawlogs for a later harvest.

There are other somewhat different examples, in the California Pine and Redwood Regions, of owners, large and small, merely letting nature take her course, but excluding fires so diligently, that adjoining old growth was able to cast seed into the clearings and reforest them. Of course, this has happened also in the Northwest. Since it is not likely that a plan was involved and that the fire exclusion was incidental to protecting active logging operations, we call this natural reforestation "accidental." A critic might argue with some justification that it could have been made a more general practice. Let us charge it off as an error of judgment and foresight. Hindsight has 20-20 vision; foresight requires strong glasses.

Industrial forestry may have been slower of adoption in California had it not



AFTER

Approximately the same view photographed in 1950. The cleared area in the foreground has been kept in grass. The seed trees in the background, plus the stump sprouts, have completely reforested that slope. Seed also has blown onto the more heavily logged area, right. The line of demarcation between the two methods of cutting on the slope is still visible.

been for the interest of certain leaders, several of whom have been mentioned earlier. Their experimentation created interest among others. Although the interest lay dormant at times, it was more easily reawakened as the economic climate improved.

The State Board of Forestry, created in 1885, although pointing an accusing finger at lumbermen, was more tactful and cooperative than most contemporary conservation organizations and, over its long history, obtained the enactment of some excellent legislation which, in the main, met approval by lumbermen.

Industrial forestry in California has had and still has some problems not encountered in the same degree in other forest regions. The summer climate that is so unfavorable to the establishment of natural and artificial reproduction has already been mentioned. We have also the steady loss of acreage of commercial forest land, a possible water crisis, taxation, and too small an outlet for leftovers.

ACREAGE LOSSES

California is steadily losing productive commercial forest land to summer homesites, power lines, ski areas, dams, roads, and other uses. The greatest loss probably will be to recreation areas and park extensions.

While most of our reservoirs are below the commercial timber belt it is quite likely that many supplementary dams and reservoirs will be built at higher elevations where they will submerge very productive forest land. There will likely be a continuing battle over projects designed to impound water in northern California for transfer, five hundred to seven hundred miles, to southern California. Water conservation is so important in California that industrial

forestry and public forestry will have to take cognizance of watershed protection as well as of timber production. Some extremists want all logging stopped.

TAXATION

Taxation of forest land is a problem in California, as elsewhere. We do have a reforestation law, enacted in 1924, which exempts residual stands and planted trees for at least forty years, or until the new growth is declared merchantable. This law has been an encouraging factor for selective cutting but it has revealed some flaws that must be remedied, particularly as to stand improvement work. Californians favor some kind of deferred tax on young growth, payable when products are cut, but the present ad valorem taxation of old growth, they believe, should not be changed. Taxation, unless modified to suit a long-time crop-like forest, is already a serious handicap to industrial forestry extension and to the conservative cutting of second growth.

PULP INDUSTRY

At present there are only two pulp mills in California, but two more are in early prospect. Further expansion of our water supply is a handicap in some areas. But we have enough wood leftovers and the prospect of an enormous volume of thinnings to supply a vastly increased pulp-making industry. California lumbering needs such an outlet for its leftovers. As every forester and lumberman knows, a large pulp industry is the surest way of making complete utilization a reality. It is a natural complement to lumbering and nothing yet devised can do as much for the ultimate perfection of industrial forestry. It is another example of how economic changes tend toward progress.

Appropos of wood pulp there is a further change that would help industrial forestry, although only indirectly, but would be a boon to the pulp mills. It concerns lignin. While pulpwood from thinnings and leftovers brings full utilization to the tree, it incurs a 30 to 50 per cent loss in the chemical pulping processes where the lignin in the wood cells must be separated from the cellulose and lost. Solving the "lignin mystery" could well release carbon, hydrogen, and oxygen in such a combination as to make it a suitable raw material for plastics and other materials not now made of wood.

FUTURE OF LUMBER

Closely related to the further progress of industrial forestry is the future of wood. We still have some timber owners who are pessimistic about the future of lumber and feel that industrial forestry for them is a lost cause. Possibly they are influenced solely by the fact that the total consumption of lumber has not increased with population. Production in the best of the recent years has not equaled that of fifty years ago. But, if the consumption of lumber continues to average between 35 and 40 billion bd. ft. and there is every reason to believe that it will, it is all to the good. Certainly, with present-day close utilization and the better equipment, lumbering is a better business. Fewer trees need be cut to provide the products. Lumber is destined always to be a large-volume building material. It is relatively easy to manufacture. Each step in the process is one of merely changing shape and size. No expensive chemical process or heat treatment is involved.

Further market losses can be expected as the wonderful old-growth timber nears its end, but technology has already begun to make the lower grades of



Pulpwood chips. An expansion of the pulpwood market is an event eagerly looked forward to by industrial foresters. It would help make utilization complete and would make very intensive industrial forestry a reality.

the second growth serve just as well and perhaps even better than the upper grades. If lumber is not priced out of the market it will always be a volume product. But, in the future, it will have to bear also the cost of growing the trees.

Technological improvements in the application of wood go hand in hand with industrial forestry. Lumbering brings about forestry. Without lumbering there would be no forestry. The more intensive lumbering becomes the better our forestry. Technology helps preserve the market for the end material; industrial forestry is right there ready to supply the raw material.

Even if all guesses about lumber's future are wrong there will still remain the many products already on the market and those yet to come, made of wood fiber, but not resembling lumber except as to form. Products like the several synthetic boards, made of the lumberman's leftovers, on his own plant site, and competing with his own lumber product, are already so popular that expected improvements should further advance their utility and market.

For all these products—pulp, synthetic boards, and chemicals—such vast quantities of raw wood are needed as to sustain a sizeable industrial program. Combined with lumber, they set the stage for a type of industrial forestry that will amaze the world. It is not only sawlogs that should command our interest, but fiber products as well.

FUTURE OF INDUSTRIAL FORESTRY

California's industrial forestry has had excellent leadership in its pioneer period; its quality remains so and its leaders are multiplying. Economic factors have made continuous forest production imperative. There is no longer a surplus of old growth. There is confidence in the future of wood. Trees to supply the logs and pulpwood for sustaining our sawmills and pulp mills must be grown. Most companies with a possibility of permanence have set up forestry departments on a footing approaching equal rank with their logging departments. There is more and more understanding and cooperation between loggers and foresters, a relationship that is of mutual help. More practical facts bearing on forest management are revealed from their experience. A number of industrial foresters have won positions of responsibility in general management and thus are influential in policy matters. Furthermore, they are taking over professional leadership. Owners are becoming as prideful of their forest management as they have always been of their logging and milling operations.

With such a background, industrial forestry can go only in one way—forward. The job is not done. We are still in the rough. The growing capacities of our forest soils and the possibilities of management techniques are not yet fully known, although certainly well beyond our present realizations.

The enthusiastic, inquiring, industrious, imaginative young men now directing and yet to direct private forest management operations are to be envied. They have a most fascinating, stimulating, and satisfying job. Their major reward is their accomplishment in the woods, working with natural laws, learning and understanding them, and working with them to grow the largest volumes of the best wood per acre per year.