AN OUTLINE OF GENERAL FORESTRY

REVISED AND ENLARGED

by

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PREFACE TO THIRD AND ENLARGED EDITION

The third edition of this Outline of General Forestry includes several new chapters, a number of rewritten chapters, and much up-to-date information on a wide range of forestry topics. These modifications and additions were made necessary by the rapid development and extension of forestry in recent years. Important recent books and articles have been added to the selected references listed at the end of each chapter.

This Outline is designed primarily as a general introduction to forestry and other closely related branches of conservation. It is not intended as a complete textbook nor as a research contribution but rather as a guide to a general understanding of what forestry is, how it is developing, what it is doing, where it is heading, why it is needed, and what benefits it is bringing to mankind.

This little handbook is the outgrowth of many years of teaching forestry to young folks, adults, forest workers, and students at professional forest schools. While intended primarily for students f forestry, it should also be of real service to laymen and forest workers engaged in a wide range of forest activities. For the student of forestry it should reduce laborious note-taking, stimulate thoughtful discussion, and open the gateway to a better understanding of the more specialized fields in forestry. For the layman it should outline and interpret the general fields of forestry and serve as a syllabus for additional readings and studies. It should be especially helpful to forest workers who wish to become more familiar with the environment in which they are working and acquire a better understanding of the aims and purposes of the enterprise in which they are earning their living.

In recent years forestry has progressed so rapidly, that the few general textbooks now available are out-of-date. This situation prompted the preparation of this book and made it necessary not only to outline essential information but also in places to include full descriptions and detailed explanations. An unusually large number of references are listed. This makes possible the selection of such references as are applicable to the particular study plan in use. It is strongly recommended that special attention be given to current literature in forestry and conservation.

Throughout the book an attempt has been made to direct thoughts towards the forest itself, for it is there that the real lessons of forestry can be learned. It is also hoped that this outline will help to lift the tone and temper of American Forestry so that it can make even greater and better contributions to human welfare.

J. S. I.

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FORESTRY AND HUMAN WELFARE

I. FORESTS AND HUMAN PROGRESS

In every land and in all ages forests have had a profound influence on the progress and welfare of mankind. The story of man's progress from a primitive cave-dweller to the master of the civilized world cannot be told without frequent reference to his contacts and relationships with forests and their many influences, products, and services. Without wood, and it is only one of many forest products, the history of most countries would have been decidedly different.

Under certain conditions man was almost entirely dependent upon the forest for shelter, sustenance and other essentials of life, while at other times and places he lived, at least temporarily, almost, if not entirely independent of the forest. In his wanderings over the face of the earth man has at times strayed away from the forest, but more often he remained in close contact with it, and frequently he found it necessary to return to the forest to replenish his supply of the necessities of life.

A. Forests and the Ancients

The forest's contributions to man's welfare have varied greatly from land to land and from time to time. The early races of man were probably not forest dwellers, for very few remains of our prehistoric ancestors have been found in densely forested regions, but authentic records show that early in the history of the human race, man developed a close association with the forest. It provided him with shade, shelter, protection, food, clothing, tools, and other simple needs. In ancient times wood was indispensable as a fuel, and in Greece and Rome it was especially essential in naval construction.

B. Forests in the Middle Ages

During the Middle Ages man generally lived in a forested environment against which he was often forced to struggle to clear land for homes, fields, and pasture. Authentic records show that as early as the thirteenth century sawmills began to operate in France. Supplying wood for fuel in large cities rapidly developed

into a big business. Wood in the form of charcoal was used widely in many industries. The forest provided food for their animals as well as themselves and raw materials for the manufacture of articles which they sold at fairs.

During the period between the sixteenth and eighteenth centuries a rapid growth of navies occurred in England, France, Holland and Spain. England of necessity had to import her lumber for shipbuilding. For this reason she planned to develop her American colonies so as to produce the needed timber. Colonial records show that in 1754, North Carolina and South Carolina exported 1,876,330 boards, 210,000 ship timbers, and 3,042,000 feet of other wood for naval construction.

C. Forests and Early American Settlers

When the first white settlers came to America they found forests everywhere. They extended practically unbroken from the Atlantic on the East to the prairies of the Mid-west. The Rocky Mountains were covered with extensive stretches of forests and the Pacific Coast region comprised some of the heaviest and finest stands of timber in the world. Approximately one-half of what is now the United States was covered with timber. Some of the forest growth was open and scrubby, especially on the edges of the deserts, the fringes of the prairies, the summits of high mountains and the borders of natural meadows, but for the most part the forest stands were unbroken, dense, and heavy. Millions of acres were covered with giant trees, often 100, 200, or even 300 feet high.

The Indians, who lived here before the white settlers arrived, had modified the forest very little. The total number of Indians in this country at any time probably did not exceed three-quarters of a million. Their small number couple with their wide distribution resulted in a very slight modification of the forest. Furthermore, the attitude of the Indian towards the forest was that of admiration and preservation. With few exceptions the lands on which they had lived for generations were left by them in a rich, productive, and unmodified condition. But it did not remain so, after the white settlers arrived and began their destructive conquest of the greatest forest heritage ever given to man.

That the forests were both a help and a hindrance to the early settlers is written indelibly into the records of pioneer life. From the forest the early settlers obtained material for their log cabins, sheds for their livestock, and firewood to keep warm during long cold winters. The blockhouses and stockades, to which the men, women and children fled in times of danger, were also built of material taken from the forests. The plows that tilled the soil,

the implements that planted and harvested the crops and the fences that protected the field were chiefly products of the forest. Much of the food, clothing and medicine of the early settlers came from the forest, including berries, nuts and the flesh and fur of wild animals. Squirrels, rabbits, deer, bears, partridges, wild turkeys and wild pigeons were plentiful. Some years wild pigeons appeared in flocks of millions. They were usually most numerous in spring, when they sought food in the forest, particularly nuts, acorns, buds, and tender young leaves. At that season of the year the pioneer settlers were often near starvation after a long unproductive winter and the choice meat of the wild pigeons was as welcome and satisfying to them as "manna" was to the Israelites. In the early days of the Genesee country of western New York a clergyman is reported to have thanked the Almighty for "pigeons — our daily bread."

That the extensive stretches of unbroken original forests that covered practically the entire eastern United States were also a real obstacle to the progress of early colonists is certainly true. They occupied the soil needed for crop production, prevented the growth of grass needed for feeding livestock, served as a cover for destructive wild beasts and provided a hiding place for Indians. For these and many other good reasons, the forests were cut down and burned to make clearings for cabins and gardens, and to open up fields for crop production. In rapidly increasing numbers small scattered fields were extended into large farms. Under these pioneer conditions forests were things to be conquered. They were obstacles to development. In fact, they had a negative value. Under such conditions the destruction of forests was a necessity. In many places the forests were not only an obstacle to progress, but at times a real threat to the existence of the early colonists. On the whole, however, forests were a far greater help than hindrance to the early settlers.

D. Forests and Agriculture

The forests of our country have always made helpful contributions to agriculture. From the very beginning of agriculture, forests have provided a substantial supplementary income to farmers without which it would have been difficult for many of them to make a good living.

During the first century of our nation's history, the settlers were so few in number and so local in distribution that they did only insignificant damage to the forest, in spite of the fact that they burned entire valleys and adjoining mountain sides to open up tiny garden patches and small clearings for fields. The destruction of forests for farming continued year by year and generation by generation and progressed at a greatly accelerated rate because

of the rapid increase of population, and yet no notice was taken of the situation until about the time of the Civil War, when a few persons of vision began to foresee that something serious was in the offing for the American forests. It is quite significant that at this time the American lumber industry began to expand and within several decades became one of our greatest industries. We know now that more forests were destroyed to make way for agriculture than for any other single purpose.

Abundant proof is at hand to show that the farmers' attitude towards the forest has changed. In place of the pioneer's attitude of destruction, the farmer of today treats his forest with an attitude of care and conservation. Now the farmer is one of our greatest wood users. He is also one of our greatest wood owners, for one-third of the total forested lands of the nation is on farm property. Farm woodlands, including submarginal farmlands suitable chiefly for forestry purposes, cover an area of 185 million acres in the United States. They provide a livelihood for thousands of rural workers. Official figures show that more than two and one-half million farmers derive part of their cash income from farm woodlands.

E. Forests and Lumbering

The forests of the United States made possible the development of a great lumber industry. From a small beginning in colonial days, it has grown into one of the leading industries of our nation. Of our 20 leading industries, not including agriculture or railroads, the lumber industry in 1930 ranked second in the number of persons employed, third in the extent of investments, and eighth in the value of its products. Normally more than one million persons are employed directly in the lumber industry, and together with other forest industries support is given to more than five million people. It is estimated that an equal number are supported in the transportation, distribution and manufacture of products dependent upon wood as a raw material.

F. Forests and National Prosperity

Forests contribute to the prosperity and welfare of a nation only to the extent that their products are of use and service to man. The people of practically all nations use the forest or its products in one form or another. Even the Eskimos, most of whom live far from forests in the frozen Arctic regions, are not entirely independent of the forest, for they prize the driftwood brought to them by the shifting tides. Races living in the dense forest jungles of Africa and South America may receive little benefit from them beyond an environment in which to live. The nation with the largest area of forest land and the densest and heaviest stands of timber

may not be prosperous, for the timber may be inaccessible or otherwise satisfy few, if any, human needs. Fortunate is the nation that possesses extensive forests stocked with valuable trees whose products are needed and used widely by man in his everyday life. Such a favored nation is the United States.

II. THE VALUES OF FORESTS

Forests have always played an important role in human affairs. They are instruments for human welfare. Some of their values are well known, others are often overlooked, and none of them are fully understood. Slowly we are getting a better understanding of these values, but to appraise them properly, it is necessary to consider not only their products, but also their influences and services.

A. Kinds of Forest Values

The values of our forests are many and various. For study purposes they can be grouped under the following headings:

1. They produce primary forest products, such as lumber, poles, posts, cross ties, mine timber, pulpwood and fuelwood.
2. They produce secondary forest products, such as bark, nuts, fruits and decorative materials.
3. They produce derived forest products, such as dyes, oils, resins, tannins and cellulose.
4. They produce accessory forest products, such as sand, clay, stone, coal, gas, oil, and other minerals and metals.
5. They produce forage for cattle, sheep and other domestic animals.
6. They produce food, shelter and habitats for wildlife.
7. They provide opportunities for healthful outdoor recreation, including hiking, camping, hunting and fishing.
8. They protect watersheds, regulate streamflow, check floods, and conserve soil.
9. They serve as windbreaks and shelterbelts and provide safeguards against drought.
10. They supply materials and environments for study and research.
11. They beautify the earth and provide sanctuaries for spiritual contemplation.

B. Classes of Forest Values

Forest values can be classified under the following headings:

1. Commercial values
2. Social values
3. Biological values
4. Physical values
5. Scientific values
6. Aesthetic and spiritual values

C. Factors Influencing Forest Values

All forest values rarely exist in a single forest. They usually vary from forest to forest, from place to place, and from time to time. Among the principal factors that determine forest values are:

1. Their composition
2. Their condition
3. Their location
4. Their productive capacity
5. The supply of forest products
6. The demand for forest products
7. The importance of forest influences
8. The need for forest services
9. The purposes of forest ownership
10. The intensity of forest management
11. The extent of forest development

III. FORESTRY AND AMERICA'S FUTURE

Without the products, influences, and services of forests, it would be impossible for the people of this country to maintain their present standard of living. History teaches that the more prosperous nations are those having an adequate acreage of productive forests. It is fair to assume that forests will be fully as important in the future as they are today.

Productive forests are possible only by the sustained and effective practice of good forestry. The welfare of the American people is dependent upon carefully devised plans for forest conservation. To mature crops of forest trees usually require several human generations, so provisions for future needs must be made early. Obviously, present needs for forest products are being met by a supply grown largely before our time. Responsible citizens will readily conclude, therefore, that the coming generation may justly hold us accountable for maintaining a continuous growth of good forests. The future of our nation is not secure without productive forests. They have been one of the great sources of our prosperity, and if handled properly, will continue to add greatly to our prosperity, happiness and general welfare.

IV. NEEDED AN ENDURING FORESTRY PROGRAM

Among the outstanding economic and social needs of the United States today is an enlarged and enduring forestry program. For such a program some lessons can be learned from other countries. In China one can see the evils of excessive forest destruction and prolonged forest deterioration. In France, Germany, Sweden, Switzerland, and other European countries are countless examples of the benefit that flow steadily from well-managed forests.

That considerable progress has already been made in forestry in the United States, largely since 1900, is in evidence in all parts of our country. There are many reasons for gratification in these

past accomplishments. But far more important are the things that still remain to be done to put forestry on a sound footing so that it can contribute its full share of benefits to both the present and future generations. Almost half a century of progress in forestry has shown conclusively that the forest problems of the United States are so different from those of other countries that a distinctly American forestry program must be worked out. We are not suffering from a lack of forestry programs, but our important task is to see to it that they are so directed that sound forest practices will become the rule rather than the exception in the handling of forest properties. Too much of our forestry is on paper and not enough in our forests.

Forestry cannot be accomplished by a single effort or handled by a single agency. It requires the cooperative effort of everybody. The business man, the farmer, the cattle man, the law maker, the scientist, the educator, the laborer, all have a part to play in this vast cooperative movement. Directly or indirectly forestry benefits everybody. Therefore, good citizenship calls upon all of us to support an enlarged and enduring forestry program. The youth of America is already giving a great public service to this worthy effort in public welfare.

> "Our forests, with their manifold resources and products, with the abundant opportunities they provide for recreation and inspiration, have been and continue to be a part of the basic pattern woven into our national fabric. Their well-being is essential to the well-being of our people themselves. Indeed, it is fortunate that the needs of the forest and the needs of our people fit so well together."
>
> FRANKLIN D. ROOSEVELT
> *President of the United States*

QUESTIONS

1. What contributions did forests make to ancient life? How did the forest benefit the people of medieval times?
2. What benefits did the early American settlers get from the forest? In what ways did the forests handicap the American pioneer?
3. In what ways did the forests of the United States help the development of agriculture? To what extent and in what manner do forests benefit agriculture today?
4. What contributions did the forests make to the development of lumbering from colonial days to the present time?
5. Outline the principal ways that forests contribute values to our everyday life?
6. Under what general heading may forest values be classified?
7. List ten important factors that influence forest values.
8. Tell why we could not live comfortably and securely without forests.
9. Why are forests an essential resource for the future of the United States?
10. Tell why an enlarged and enduring forestry program for the United States is justified.

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CHAPTER II

WHAT A FOREST IS

I. THE MEANING OF A FOREST

To understand forestry one must know something about the forest itself. First of all, it is important to know that a forest is not a fixed resource, a final product, or an end in itself. Instead, a forest is an ever-changing renewable resource, differing widely from place to place and from time to time. Equally important is the fact that trees alone do not make a forest. Associated with trees are many other kinds of plants, animals, and soil life.

A. Different Meanings of a Forest

There is no fixed meaning for the word forest. People living in the same country and with the same background of education and experience often have decidedly different ideas as to what a forest is. Even faculty members and students of the same forest school use a wide range of descriptive terms to define a forest. Among the basic meanings of a forest are:

1. A collection of trees
2. An association of plants
3. A community of living things
4. A tract of land stocked with trees
5. A property
6. An administrative unit, e.g. the Plumas National Forest or the Penn State Forest
7. A renewable resource
8. A public utility
9. A human need or service

B. Selected Definitions

The following definitions show how completely the meaning of the word forest has changed during the past two centuries and how wide a range of meaning this simple word still carries:

1. A forest is a certain territory of woody grounds and fruitful pastures, privileged for wild beasts and fowls of forest, chase, and warren, to rest and abide there in the safe protection of the king, for his delight and pleasure; which territory of ground so privileged is meered and bounded with unremovable marks, meers and boundaries, either known by matter of record or by prescription; and also replenished with wild beasts of venery or chase, and with great coverts of wert, for the succor of the said beasts there to abide; for the preservation and continuance of which said place, together with the vert and venison, there are particular officers,

laws and privileges belonging to the same, requisite for that purpose, and proper only to a forest, and to no other place.—*Manwood's Treatise of the Forest Laws, 1717.*

2. A forest is waste grounds belonging to the king, replenished with all manner of beasts of chase or venery, which are under the king's protection for the sake of his royal recreation and delight.—*Blackstone.*
3. A forest is a tract of land covered with a natural growth of trees.—*The New International Encyclopaedia.*
4. A forest is an area of land on which forest trees are the dominant vegetation.—*H. H. Chapman, 1932.*
5. In common usage, a forest is a large tract of land covered with trees; more exactly, a tract of land, more or less extensive, covered more or less densely with trees of useful character, viewed from the standpoint of economic use and development. A species of woodland or woods, which is the generic term for wooded conditions of the land—*Committee, Society of American Foresters, 1917.*
6. A forest is any tract of land, usually characterized by a predominant growth of trees, maintained and managed for various human utilities —*Waugh, 1922.*
7. A forest is a plant society of arborescent and shrub species which has both an economic and biological significance—*Encyclopaedia Britannica.*
8. A forest is essentially a partnership of trees, plants and animal life. It is a portion of the earth where trees, soil life, animals and plants are living in close association and have come to depend in varying degrees on each other for their welfare, even though in another sense they are often at war, one with the other.—*Pack and Gill.*
9. A forest is a community of trees and associated organisms covering a considerable area; utilizing air, water, and earthy materials to attain maturity and to reproduce itself; and capable of furnishing mankind with indispensable products and services.—*Allen, 1938.*
10. A forest is a complex community of plant and animal life, dominated by trees and associated with a specific area of land.—*1938.*

C. Terms Closely Related to Forest

Woods	Forestland
Woodland	Timberland
Woodlot	Timber
	Wilderness

Woods and woodland are broad general terms used to indicate the wooded condition of land. A woodlot is generally considered a rather small wooded tract, usually the forested part of a farm. Timber and timberland refer to large forested areas producing logs, poles, posts and other wood products for commercial purposes.

II. THE STRUCTURE OF A FOREST

A forest is more than a grouping of trees or stands of trees. Associated with the trees are shrubs, wild flowers, ferns, mosses, liverworts, fungi, algae and other forms of plant life. And intermingled with this plant life is an equally complex association of beasts, fowls, bugs, snakes, snails, worms and other forms of animal life. All these living things are a part of the forest.

To know the structure of the forest well one must know not only the plant and animal life above the soil, but also the soil itself with its many minute plants and distinctive animal life. The soil is the foundation of the forest. The leaf litter and humus that covers the soil are highly important. The forest soil teems with countless worms and other living things. Some are visible; others can be seen only with powerful microscopes. Without this soil life, the forest could not exist.

Each forest has a make-up and character of its own. It has its own trees, its own soil, its own atmosphere, its own subordinate plant life and its own animal life. This explains why there are so many different kinds of forests.

III. DIFFERENT KINDS OF FORESTS

Many different kinds of forests are generally recognized. They can be grouped on the basis of:

A. Composition and Condition

1. Original, primeval or primitive
2. Softwood, coniferous or evergreen
3. Hardwood, broadleaf, or deciduous
4. Pure and mixed
5. Open and dense
6. Cut-over and fire-culled
7. Temporary and climax

B. Age and Maturity

1. Even-aged and many-aged
2. Old growth, second growth and young growth
3. Over-mature, mature and immature

C. Location and Distribution

1. Tropical and subtropical
2. Arctic and subarctic
3. Southern pine and northern hardwood
4. Rocky mountain and Pacific coast
5. Prairie or plains
6. Alpine and lowland

D. Ownership and Jurisdiction

1. International
2. National
3. State
4. County
5. City (municipal)
6. Community (communal)
7. Institution
8. Association
9. Corporation
10. Estate
11. Cooperative
12. Private

E. Purpose and Function

1. Production
2. Commercial
3. Protection
4. Preservation
5. Demonstration
6. Research
7. Recreation
8. Wildlife management
9. Watershed protection
10. Shelterbelt or windbreak
11. Multiple-purpose
12. Memorial

F. Treatment and Management

1. Unmanaged, mismanaged and managed
2. Intensive and extensive management
3. Normal or ideal
4. Continuous
5. Selection
6. Shelterwood
7. Coppice
8. Clear-cut

Forests can also be divided into two broad groups, namely, (1) natural or undeveloped forests and (2) managed or developed forests. Nature provided the former; man is working with the latter. The forester's forest is very different from nature's forest. The former includes roads, trails, bridges, dams, reservoirs, telephone lines, power lines, fire towers, radio towers, forester's homes, ranger stations, garages, workshops, cabins, shelters, fireplaces, boundary markers, signs, posters, and hundreds of other forms of improvements. All these are essential parts of a forest property. It is important that we think more and more in terms of the forester's forest with its many improvements and developments.

IV. THE LIFE OF A FOREST

A forest is a living renewable resource with a life of its own. Each forest is a complex community of many different kinds of living things. One of the first things to know about the life of a forest is that its members help and harm each other. Big trees beget and shelter little trees. They also suppress and kill them. Trees feed fungi and fungi kill trees. Trees provide food for insects, and insects may be forest enemy number one. Trees and shrubs provide food and envronment for wildlife, and wildlife often interferes seriously with forest growth and sometimes completely destroys it. One of the first lessons the student of the forest learns is that the source of forest life is in the soil and in the sunlight, and that the members of the forest may be mutually helpful or highly competitive with one another. It is especially significant that one of the most destructive enemies of a tree is the height growth and shade of a neighbor tree. What the plants and animals of the forest do is not yet fully known. Much is still to be learned about the complex life of the forest. To understand and control the life of the forest is one of the main tasks of a forester.

V. THE GOOD OF A FOREST

What good is a forest, is a question that has come down to us through the ages. More than two centuries ago Lord Coke told us that a forest is good for many things. From generation to generation the forest has been serving mankind, and today as much as ever before we are dependent directly or indirectly upon the forest for some of the most essential things for life.

Wood ranks first among the many products of the forest that we need in our everyday life. Even in a rough form wood has many uses and in a semi-converted form its uses go into the thousands, and innumerable are the articles used in our daily life, such as paper, rayon, cellophane and artificial leather, that are made wholly or in part from wood, but in which wood has lost its identity.

In addition to wood the forest produces many other products of great importance, and often vital to man's existence. Among these are nuts, berries, wildlife and forage for domestic animals.

The good of the forest is not limited to forest products, for the forest brings many other benefits and services to mankind. If you should follow a tree from the forest to the factory or the home you would be amazed at the amount of work required to prepare it for final use. The forest provides employment regularly for many people, and during periods of unemployment offers one of the best opportunities for emergency work. The forest also regulates streamflow, protects mountainsides against erosion, provides recreation and ameliorates climate. And above all these physical values, is the inestimable good that forests do to make our nation, our state, our city, our town, our home a beautiful place to live in. By adding together all the good things the forest does we cannot escape the conclusion that the forest is a real, positive human necessity, and without good forests mankind cannot maintain itself well and certainly not prosper. For a more detailed listing of forest values see page 5.

To know the good of forestry one must know the good of the forest. Every forest is good for something. Most forests are good for many things. The good that comes from forests increases with the care that is given them. The well-managed forest provides the most good.

QUESTIONS

1. Explain why a forest is more than a collection of trees or a tract of land.
2. Under what conditions is a forest an administrative unit?
3. Compare Blackstone's definition of a forest with recent definitions.
4. In your opinion what is a good definition of a forest?
5. What are the principal components of a forest?
6. Why are there so many different kinds of forests? On what different bases can they be classified?
7. What is a national forest? a state forest? a second-growth forest? a protection forest? a selection forest? a multiple-purpose forest?
8. What are the main differences between unmanaged, mismanaged and managed forests?
9. Compare undeveloped with developed forests.
10. Why is it important for a forester to understand the life of a forest?
11. Explain why the soil and the sunlight are the sources of forest life.
12. What is a forest good for? Is every forest good for something? In what way is a managed forest better than an unmanaged forest?

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Author's Note: Lantern slides, photographs, charts and maps are helpful in presenting this chapter, especially in considering the many different kinds of forests. Field trips to local forests should be taken whenever possible, and reports on all field trips are recommended.

CHAPTER III

WHAT FORESTRY IS

I. THE MEANING OF FORESTRY

Forestry embraces a rapidly widening field of diversified activities. Because of this ever-widening scope of forest activities and ever-changing emphasis in forest practices not all people have the same idea of forestry. Among the different meanings of forestry used in this country are:

1. A subject to study
2. A career to choose
3. A movement to support
4. A problem to solve
5. A science to foster
6. An art to practice
7. A technique to use
8. A policy to administer
9. A program to work
10. A business to manage
11. A property to handle
12. A service to give

In everyday usage the term "forestry" is rarely limited to any one of these specific meanings. Usually it includes several of these concepts, and in its broadest sense it may include all of them. Sometimes it is spoken of as "a fad," "a pastime," or "a noble experiment," and occasionally it is called "an economic challenge." The present trend, however, is to think of it more and more as a program to work, a business to manage, and a service to give.

A. Different Definitions

There is no one generally accepted definition of forestry. Perhaps there never will be a single definition, for it is difficult to condense the full meaning of so broad a subject into one — or several — sentence descriptive statement. A comparative study of definitions of forestry during its half century of development in this country reveals an extremely wide range of interpretations and drastic changes in emphasis on different phases of this important subject. The following selected definitions by eminent foresters and outstanding authorities is offered to show the wide range of interpretations:

1. Forestry is the preservation of the forests by wise usage.—*Theodore Roosevelt.*
2. Forestry is the rational treatment of forests for forest purposes.—*Bernhard E. Fernow.*

3. Forestry is the science and art of growing timber.—*Encyclopaedia Britannica.*
4. Forestry is the growing of timber and wood.—*Liberty H. Bailey, 1909.*
5. Forestry may be defined as the art of raising repeated crops of timber and other forest products on soil unsuited to agriculture.—*Moon and Brown, 1914.*
6. By forestry is understood the sum total of all activities having reference to the most opportune treatment and to the continuous utilization of woods, with due regard to the local purposes of their owners—*R. Hess* in *Encyclopaedia of Forestry.* (Translated from German text).
7. Forestry comprises the sum total of all knowledge required for the best administration of the forests, with due regard to the interests of the owners in particular, and to the interests of the commonwealth in general. —*A. Parade.* (Translated from French text).
8. Forestry treats of the relations of forests to human welfare. It constitutes the science and art of controlling, protecting, producing, and utilizing forests in order to realize the largest possible human benefits from their existence and use.—*H. H. Chapman, 1931.*
9. It is the purpose of forestry to obtain from forest lands and their products the greatest economic, industrial and human service. The success of forestry is measured in benefits to mankind and its aid to the progress of civilization.—*Graves and Guise, 1932.*
10. Forestry is a comprehensive and coordinated technique of land management. It is land and resource management in the widest sense.—*Sparhawk and Show, 1933.*
11. Forestry is the purposeful use of forest for human benefits.—*S. O. Heiberg, 1937.*
12. Forestry is the science and art of managing forests so that they yield continuously their maximum of wood products, values and influences.— *CCC Forestry, 1937.*
13. Forestry is the science of the forest. It is also the art of getting from a forest whatever it is best able to yield permanently for the use of man.— *Gifford Pinchot, 1937.*
14. Forestry is the science, art, and business of producing, improving, and managing forests and of utilizing their products and services.—*S. T. Dana, 1938.*
15. Forestry is the purposeful development and use of all forest resources for the services of mankind, *1938.*

B. Meaning of Forestry Has Changed Greatly

Through decades and centuries of development the meaning of forestry has changed greatly in this country and in foreign lands. When forestry started in Europe in a small way about 500 years ago it was concerned chiefly with the beasts and fowls of the forests plus a few general regulatory measures. As early as 1359, the forest belonging to the city of Ehrfurth in Germany was divided into seven parts for general management purposes, and in 1422 the city council of Zurich, Switzerland regulated the cut of its city forest, called Sihlwald, to not more than 20,000 pieces of timber per year. During the intervening centuries, but especially the past

150 years, forestry in Europe has enlarged its meaning and broadened its scope until now it is classed among the broad purposes of government and the big businesses of private enterprise.

Similarly the meaning of forestry has changed in this country during its relatively short period of development—approximately 50 to 75 years. At first forestry was largely a matter of collecting and disseminating information. In rapid succession forest preservation, forest reservation, forest protection, forest acquisition, reforestation, forest management, and forest administration were included among the regular forestry activities. Now forestry in the United States functions throughout as broad a field as in Europe, and with this broadening of scope there has been a corresponding broadening of its meaning. Sometimes forestry is given a meaning that is practically as broad as that of conservation.

II. THE WIDENING SCOPE OF FORESTRY

With each forward step that forestry takes, its scope is becoming wider and wider. In the early days forestry concerned itself chiefly with the location of forest properties, the description of forest conditions, the study of tree habits, the growth of timber, the effects of forest fires, the uses of wood, and other closely related subjects. From this restricted scope it has grown until now its ramifications extend to almost all lines of human endeavor, including the use of forests for recreation, the chemical utilization of wood for paper, rayon and artificial leather, the preservative treatment and kiln drying of lumber, the classification of land uses, the conservation of wildlife, and emergency plans for human betterment. This rapid extension of forestry has resulted in many erroneous notions and foggy conceptions of what forestry really is. Many of these misconceptions can be cleared up by considering some of the aspects of forestry that are often confused with it.

A. Forest Preservation

Forest preservation is only a small part of forestry. By many, forest preservation was regarded, especially in the early days of conservation, as synonymous with forestry. Such terms as forest preserves and forest reserves attest to this narrow concept and restricted usage.

B. Wood Production

Wood production is an essential part of forestry. There was a time when the growing of timber was regarded as almost synonymous with forestry. As late as 1909, Prof. Liberty H. Bailey in his *Principles of Agriculture*, wrote "Forestry is the growing of timber and wood" and in the *Encyclopaedia Britannica* we read "Forestry is the science and art of growing timber." Today these narrow single purpose definitions are no longer adequate.

C. Forest Exploitation

Prevention of excessive forest exploitation and forest deterioration is an essential part of a complete forestry program. However, from time to time such strong emphasis has been placed upon the extent and consequences of forest destruction, forest devastation, and forest depletion that it appeared as if there was little else to forestry than the prevention of these things. We know now that forestry has a much broader meaning.

D. Forest Protection

Protection of forests against fire and other destructive agencies is the most fundamental activity in forestry. A few foresters have gone so far as to say that "forest protection is 90 percent of forestry." More than a half century of experience in American forestry offers ample proof that the best protection of forests against fire and other destructive agents does not by itself guarantee good forestry. Adequate provisions must also be made for other essential forestry activities. This can be done without subtracting from forest protection, which unquestionably remains the most necessary branch of forestry.

E. Reforestation

In some parts of the country, particularly in the East, the South and the Lake States, reforestation is a leading forestry activity. In some localities the word forestry means practically no more than reforestation. Forestry is, however, much more than forest tree planting with all its attendant activities.

F. Extension of Scope

The scope of forestry is already quite broad. The present trend is towards an extension rather than a restriction of its scope. To have the whole of forestry develop effectively, it is important that its scope be not limited to any of its parts, irrespective of their local or general importance. Instead, that forestry will prove best which effects a properly balanced coordination of all its parts, including forest protection, reforestation, forest production, forest preservation, forest utilization, and other essential activities.

III. KINDS OF FORESTRY

Forestry has become so diversified that many different kinds are now functioning. On the basis of ownership and jurisdiction the following kinds are generally recognized:

Public Forestry

1. Federal (national) forestry
2. State forestry
3. County forestry
4. Municipal (city) forestry
5. Community forestry

Private Forestry

1. Industrial (commercial) forestry
2. Farm forestry
3. Estate forestry

In general and local use are also such terms as practical forestry, scientific forestry, extensive forestry, intensive forestry, conservative forestry, cooperative forestry, and multiple-purpose forestry.

IV. THE RELATIONSHIPS OF FORESTRY

Forestry has a wide range of relationships. They can be grouped under (1) external relationships and (2) internal relationships. The former include relationships with subjects and activities outside of its own field of operation and the latter pertain to subjects and activities within the field of forestry itself.

A. External Relationships

Among the subjects and activities with which forestry is rather closely related outside of its own field of operation are:

1. Agriculture
2. Botany
3. Arboriculture
4. Horticulture
5. Landscape Architecture
6. Conservation
7. Government
8. Health
9. Welfare
10. Education
11. Engineering
12. Lumbering

In the early days of forestry, many authorities regarded it as a subject in agriculture. Cheyney and Wentling in their book on *The Farm Woodlot* write that "In a broad sense, all forestry is agriculture, because it is the rearing of a crop from the land." One of the most outstanding contemporary authorities on agriculture roughly divided agriculture into four main branches, namely: (1) agriculture in its restricted sense, (2) animal industry, (3) horticulture and (4) forestry. A well-known forester recently wrote "forestry is farming applied to woodlands," and another forester declared that "forestry is tree farming." An unbiased survey of the situation shows, however, that forestry has developed in such a distinctive way that it is now generally regarded as a division of conservation or as a separate field of work, but related rather closely to a number of aspects of agriculture and other land use enterprises. In the field of forest education, agriculture and forestry remain closely related but in the business aspects of forestry there is less contact with agriculture.

In its development forestry has shown also a rather close relationship to botany, the latter being usually defined as the study of plants or as the study of the vegetable kingdom in all of its divisions. In a considerable number of colleges and universities general courses in forestry are given in the department of botany. In others, it is given in the departments of arboriculture or horticulture. Arboriculture treats of the care and handling of individual trees or small groups of trees, chiefly for ornamental purposes.

Horticulture is the growing of fruits, vegetables and ornamental plants. Forestry also has many contacts with engineering, including landscape, civil, mechanical and chemical engineering. Its relationships with lumbering have always been close, and closest of all are its relationship with other branches of conservation.

B. Internal Relationship

The field of forestry has enlarged rapidly between expanding lines, and is now so wide that a number of distinct branches or divisions have become well established. The formation of divisions within forestry has been quite different in the field of forest education and in forest practice. The major subjects generally recognized in forest education are:

1. Forest Protection
2. Silviculture
3. Forest Management
4. Forest Utilization
5. Forest Policy and Administration
6. Forest Economics
7. Forest Research

In addition to these major branches of forestry are subjects such as forest mensuration, forest regulation, forest engineering, forest products, forest recreation, forest soils, forest laws, forest history, forest extension, forest entomology, forest zoology and forest pathology.

In the field of forest practice the following divisions or branches of forestry are commonly recognized.

1. Applied Forestry (Property Management)
   a. Forest protection
   b. Timber management
   c. Range management
   d. Wildlife management
   e. Recreation management
   f. Land management
   g. Forest engineering
   h. Forest improvements
2. Forest Research
3. Forest Information and Education
4. Forest Extension (Cooperation)
5. Emergency Conservation Work (ECW)

A study of the divisions of forestry as set up in forest practice shows the breadth of forestry more clearly than the subjects of study that make up the curricula of most forest schools. In some administrative setups the field of forestry practically coincides with the field of conservation.

V. FORESTRY AND CONSERVATION

Forestry rarely functions as an independent unit. Its activities are closely interrelated with those pertaining to water, land, minerals, wildlife and other natural resources. These and other

natural resources are usually handled under the collective administrative term "conservation" under which forestry has functioned in a leading role since its beginning in this country. At first conservation, as applied to natural resources, meant to preserve, to reserve, to withhold from use, to lock up, to save for future generations, to safeguard against wasteful exploitation, to prevent devastation, to halt excessive development, or to set apart for restorative treatment. In time, conservation developed a broader scope and a more purposeful meaning and application. Now it has come to mean wise use, purposeful development, orderly handling, sustained regulation, efficient management, prudent planning, and integrated administration of all natural resources.

Conservation as we understand it at present covers such a wide range of resources and comprises so many different lines of activities that a grouping of its far-flung subject material becomes necessary for an orderly consideration of its make-up and practices. The principal fields of conservation now generally recognized are:

1. Forest conservation
2. Scenery conservation
3. Wildlife conservation
4. Water conservation
5. Mineral conservation
6. Land and Soil conservation

At no time in our country's development has conservation been given the public and official support that it has received in recent years. It is now functioning on a scale unthought of a decade ago. It has won a place among important public undertakings, and in many localities has become a common household word. No single agency has contributed more to the extension of the use of the term "conservation" than the Civilian Conservation Corps (CCC camps). Administrative terms such as "Conservation Department," "Conservation Commission" and "Conservation Board" are rapidly coming into common use.

In a report of the National Resources Board issued in 1934 conservation is defined as "the orderly and efficient use of natural resources in the interest of national welfare, both in war and in peace, without unnecessary waste either of the physical resources or the human elements involved in their extraction." Forestry is regarded more and more as a part of conservation, and functions at its best not by itself, but when effectively integrated with other related land-use activities.

VI. THE PURPOSES OF FORESTRY

The purposes of forestry are usually multiple. Rarely is there only one single purpose, aim or objective in the handling of any forest property. Seldom is one purpose so overwhelmingly dominant as to justify the exclusion of all others. Several hundred years of

European forestry and about a half of a century of experience in the United States offer ample proof that the best forestry rests not upon a single purpose but a number of purposes On t.he same area of land it is often possible to grow timber, to furnish food and shelter for game animals and other wildlife, to provide protection to watersheds, to offer healthful recreational opportunities, to enhance the beauty of the landscape, and to promote the general welfare. The best forestry takes account of all these values, and works out a comprehensive and coordinated technique to handle them efficiently. Such a composite plan of management is appropriately called *multiple-purpose forestry.*

A. Multiple-Purpose Forestry

Multiple-purpose forestry has as its objective the full, balanced and sustained development and use of all forest resources. This objective is not attained easily. It cannot be reached without conscious planning and sustained management. But it promises the best returns from our forests, and anything short of the best possible returns is not good forestry.

B. Grouping of Forestry Purposes

In considering the purposes of forestry it may be helpful to recognize master purposes, general purposes and specific purposes. James E. Scott, of the U. S. Forest Service in 1937 wrote that "Forest Service energy and effort are applied along three main lines, all converging upon one master objective—the best permanent use of our forest lands and of their physical and social resources."

Among the general purposes of forestry are:

1. To promote the general walfare
2. To maintain the national defense
3. To provide a sustained supply of forest resources to satisfy human needs
4. To preserve and enhance the beauty of the landscape
5. To replenish depleted forest resources
6. To maintain favorable forest influences

Among the more specific purposes of forestry are:

1. To make money
2. To get a maximum yield of wood
3. To produce a sustained supply of wood
4. To provide recreational opportunities
5. To preserve wilderness area
6. To provide food, shelter and habitats for wildlife
7. To provide and stabilize employment (regular and emergency)

C. Public and Private Forestry Purposes

The purposes of public and private forestry are often quite different. The principal objective of most private forestry projects is to make money. However, on some large private estates, owned by wealthy individuals, clubs, and associations, and maintained chiefly as hunting and fishing preserves and recreational parks, the objectives of wood production and financial returns are often secondary. In the management of forests owned by water companies the dominant purpose is usually watershed and reservoir protection. The aim of many farmers is to produce in their woodlots, the particular class of wood and timber needed by them for local uses. On the whole, the private forest land owner looks upon forestry primarily as a money making proposition.

In the case of national, state, and other publicly owned forests the primary purpose is usually not to make money but to own and handle forest properties in such a way that they will yield on a sustained basis the fullest possible measure of human benefits in the form of products, services, and influences. However, some public forests are managed primarily for watershed protection and soil conservation purposes. In others the development and maintenance of recreational opportunities is stressed, and in still others the dominant objective is the providing of ample food and shelter for wildlife and the development of hunting grounds and fishing areas.

VII. THE PROFESSION OF FORESTRY

Forestry like medicine, law and engineering is a profession. It is a young, active and rapidly growing profession. The first professionally trained forester was graduated from an American forest school of collegiate grade in 1900. Only one forester was graduated that year. The following year five were graduated. Thereafter the number increased rapidly and by 1910 a total of 376 foresters had been graduated. From 1900 to 1937 a total of 7,003 undergraduate and 1,567 master's degrees in forestry were awarded. The largest number awarded in any one year was in 1937, when 777 undergraduate, 75 master's and 7 doctor's degrees were conferred by 25 American forest schools. During the past three years (1935—1937) the number of foresters graduated from forest schools in the United States averaged approximately 650.

The following table gives the total number of graduates of forest schools and an estimate of the number of graduates employed in forestry by decades since 1900:

Year	Total Number Graduated by Forest Schools	Estimated Number Employed in Forestry (a)
1900	1	1
1910	366	325
1920	2,030	1,500
1930	4,915	3,200
1937	8,647	6,050

In 1900 the Society of American Foresters was organized with about half a dozen charter members. It is an organization of professional foresters. The principal objectives of the society, under the articles of incorporation is to encourage a broad and constructive practice of forestry, to stimulate research and achievements in the science of forestry, and to advance the profession of forestry through cooperative thought and a spirit of solidarity among foresters.

In December 1937, it had a total membership of 4,152 foresters located in all parts of the United States and in a number of foreign countries. The society maintains headquarters' offices in charge of an executive secretary—a forester—and issues a monthly publication called the Journal of Forestry devoted to all branches of forestry.

Four Presidents of the United States (Benjamin Harrison, Grover Cleveland, Theodore Roosevelt and Franklin D. Roosevelt) were affiliated with the Society as associate or honorary members. President F. D. Roosevelt became an associate member on May 1, 1932, when governor of New York, and in 1935 was made an honorary member.

Forestry is a well-organized forward looking profession. It is primarily a profession of service, and most of its services are still in the future.

QUESTIONS

1. Explain why forestry has such a wide range of meanings.
2. Compare forestry as a science and as an art.
3. Make a comparative appraisal of selected definitions of forestry. Do they show any general or specific trends?
4. In what ways has the meaning of forestry changed with its development?
5. What are the principal kinds of public and private forestry?
6. Discuss the relationships of forestry to forest preservation, forest protection and reforestation.
7. Discuss the relationship of forestry with agriculture, lumbering and engineering.
8. Explain the interrelationship of forestry and conservation.
9. Compare the branches and divisions of forestry as used in forest education and in forest practice.

(a) Includes industry, selling and manufacture of forest products, highway and roadside forestry, etc.

10. What are important purposes in forestry? How may they be grouped? Explain why and how purposes change from time to time and place to place.
11. What is meant by multiple-purpose forestry? Explain its application in forest practice.
12. What are the principal differences in the purposes of public and private forestry.
13. What kind of a profession is forestry? What are its objectives? How is it organized? Is it a profession of service? What is its future?

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Author's Note: Approximately 25 lantern slides and other illustrative material are used in presenting this chapter to the students. A one-reel motion picture—*THE A B C of Forestry*—available for distribution through the Office of Motion Pictures, U. S. Department of Agriculture, contains excellent pictures and text material to supplement this chapter.

CHAPTER IV

TREES OF THE FOREST

I. WHAT A TREE IS

A. Definition

What a tree is, is rather difficult to explain in a short meaningful statement, for a given species may assume a tree-like form in one locality and remain a shrub in another region. Even in the same region, trees show a wide range in their development. A tree, under normal conditions, can be defined as a woody plant attaining a height of at least 10 to 15 feet, rising from the ground with a single stem, and developing a more or less definite crown shape.

B. Other Definitions

1. A woody perennial plant having a single main axis or stem (trunk) commonly exceeding 10 feet in height and usually devoid of branches below, but bearing a head of branches and foliage or a crown of leaves at the summit—*Webster's Dictionary.*

2. Trees are woody plants the seeds of which have the inherent capacity of producing naturally within their native limits one main erect axis continuing to grow for a number of years more vigorously than the lateral axes and the lower branches dying off in time—*B. E. Fernow.*

3. A tree is commonly defined as a woody plant which reaches a height of at least 20 feet, has a single stem and shows a definite crown shape. * * * A shrub, in contrast, attains a height of less than that specified for a tree and is composed of several stems with no definite crown shape —*W. M. Harlow.*

C. Parts of a Tree

1. *Roots.* They serve to anchor trees and supply them with water and essential mineral salts.

2. *Stem.* It supports the crown, transports sap and food material, and provides most of the wood and timber used by man.

3. *Crown.* It comprises the branches and twigs which bear buds, leaves, flowers and fruits.

D. Parts of Tree Stems

1. Outer bark
2. Inner bark
3. Cambium
4. Sapwood
5. Heartwood
6. Pith

II. CLASSES AND GROUPS OF TREES

A. Size Classes of Trees

1. Seedlings—Up to 3 feet
2. Saplings — From 3 feet in height to 4 inches in diameter at breast-height
3. Poles—From 4 to 12 inches in diameter
4. Standards—From 1 to 2 feet in diameter
5. Veterans—more than 2 feet in diameter

B. Crown Classes of Trees

1. *Dominant.* Trees with well developed crowns extending above the level of other associated trees, above the average in size, and receiving full light from above and partly from the side.

2. *Co-dominant.* Trees with medium-size crowns reaching the general level of the forest canopy, crowded considerably from the sides, and receiving full light from above, but relatively little from the sides.

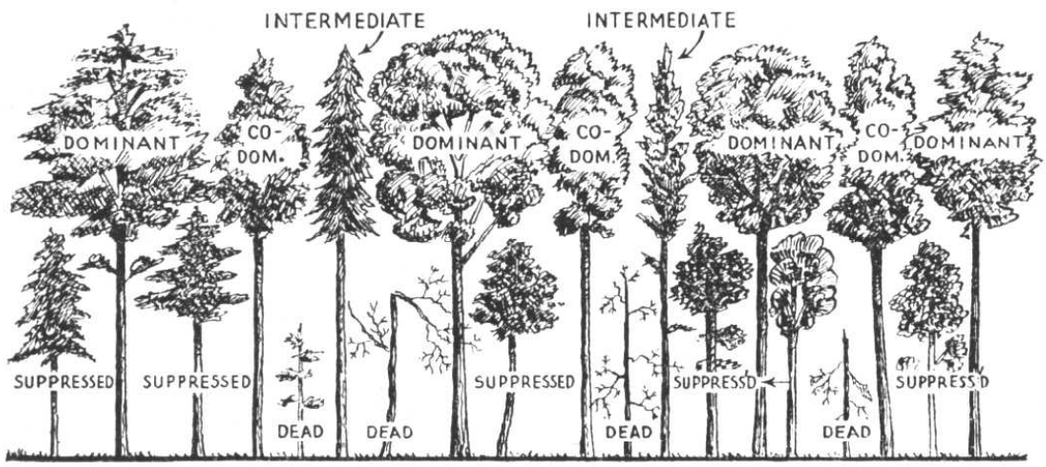

Fig. 1. Relative Position of Trees of Different Crown Classes. CO-DOM. = Co-dominant.

3. *Intermediate.* Trees with usually small crowns crowded considerably from the sides and below, but extending into the general level of the forest canopy and receiving a small amount of direct light from above and none from the sides.

4. *Suppressed.* Trees with small poorly developed crowns completely below the general level of the forest canopy and receiving no direct light from above or the sides. Some are so com-

pletely suppressed that they cannot recover even if liberated by the removal of the overtopping trees immediately surrounding them.

5. *Dead.* Trees that have been so completely suppressed that they have died. Heavily suppressed trees are often subject to attack of destructive agents such as fungi and insects.

C. Age Classes of Trees

Usually the range of a single age class is 20 years, but in European forest practice it is sometimes only 10 years. If the 20 year age class is used and the oldest trees are 120 years then there are six age classes, namely: 1-20, 21-40, 41-60, 61-80, 81-100 and 101-120 years. In general usage it is customary to speak of long-lived trees, short-lived trees, two-aged stands, even-aged stands, many-aged stands and all-aged stands.

D. General Tree Classes and Groups

1. Forest trees
2. Fruit trees
3. Ornamental trees (lawn, park, street, shade and roadside)
4. Nut trees
5. Christmas trees
6. Historic trees
7. Memorial or festive trees
8. Evergreen trees
9. Deciduous or broadleaved trees
10. Short-lived and long-lived trees
11. Dwarf trees
12. Tolerant and intolerant trees
13. Opposite and alternate-branched trees
14. Boundary line trees
15. Corner and witness trees
16. Seed trees
17. Nurse trees
18. Spar trees

There are also many special and unique kinds of trees such as bee trees, squirrel trees, wolf trees, wiffletrees, hang trees, dynamite trees, sausage trees, and monkey puzzle trees. And on the shore of Antietam Lake near Reading, Pennsylvania, stands the first Mother's Tree—a white birch—planted on Sunday, May 13, 1923.

III. GROWTH AND REPRODUCTION OF TREES

A. The Growth of Trees

Trees grow in at least three different directions:

1. In height
2. In depth (roots)
3. In width

Because of this growth they increase in volume, in quality and in value. These increases are sometimes called volume increment, quality increment and value increment.

B. How Trees Reproduce and Propagate

1. By seeds
2. By sprouts
3. By suckers
4. By layers
5. By cuttings

C. Tree Growth Requirements

That trees grow is a generally known fact, but few people know when or how they grow. Among the principal requirements for tree growth are space, light, soil, moisture, mineral salts, and proper temperature. For formation of growth rings see chapter XXII.

D. When Trees Grow

Most people believe that trees grow from early spring until late in autumn. That this is not correct has been proven by recent studies. In the latitude of southern Pennsylvania the native forest trees make approximately 90 per cent of their height growth in 40 days in the springtime. There the wild black cherry starts growing about the first of April, the tulip poplar late in April and the Norway spruce waits until early in May. For ten years the author recorded the growth of a sweet buckeye planted at Mont Alto, Pennsylvania, and found that its height growth for the season was completed by May 10. At Syracuse, New York, the white ash usually completes its height growth by the end of May. In many forest trees the height growth is completed in 35 days or less in springtime. Other trees continue their height growth for a longer period during the growing season, but most of the growth takes place in a relatively short period. In some trees, periods of growth alternate with periods of rest during a single growing season.

E. Growth Stages of Tree Stands

1. Seedling
2. Thicket
3. Polewood
4. Young timber
5. Old timber

IV. THE AGE OF TREES

A. The Big Cypress of Mexico

Some trees reach a great age. In fact, the oldest living thing in the world is a tree. Until recently there was general agreement that it is a cypress standing within a fence enclosure in the village of Santa Maria del Tule in Oaxaca, Mexico. Among its local names are Montezuma Cypress, Big Tree of Tule, and the Big Vegetable. Its age has been estimated anywhere from 3,000 to 5,000 years. At five feet above the ground, and by following the depression in the bark, it has a circumference of 108 feet. Its circumference is out of all proportion to its height, which is only 141 feet. So far as is

known no other living thing ever reached so great an age or girth. Recent reports indicate that individual specimens of the Big Trees of California may be the oldest trees of the world.

B. The General Sherman Tree

Perhaps the oldest and largest living thing in the United States is the General Sherman Tree in the Sequoia National Park in California. It is one of the well-known Sequoia, and was first discovered by a hunter on August 7, 1879. Its exact age is unknown but the best available estimates place it between 3,000 and 4,000 years. The dimensions of this tree are:

	Feet
Height above mean base	273.9
Circumference at base	102.7
Greatest base diameter	37.3
Mean base diameter	32.7
Diameter 60 feet above ground	17.5
Diameter 120 feet above ground	17.0
Height to largest branch	130.0
Diameter of largest branch	7.3

The estimated volume of the trunk of the General Sherman Tree, exclusive of branches, is 600,120 board feet. The total weight of this tree is estimated at approximately 4,300,000 pounds.

C. Other Old Trees

Other tree species such as the Douglas fir, Sitka spruce, western yellow pine, and western hemlock, may reach an age considerably in excess of 500 years. Eastern white oak occasionally reaches an age of 500 years, eastern hemlock 365 years and eastern white pine upwards of 250 years. Some trees, such as the fire cherry, and scrub oak, rarely reach an age greater than 25 or 30 years. These are among the most short-lived of our native trees.

V. MANY DIFFERENT KINDS OF TREES

A. Trees are Common

Next to the grasses, trees are the commonest type of vegetation on the earths surface.

B. Many Trees in North America

In Michaux's *North American Sylva* of 1819 appears the statement that "The species of large trees are much more numerous in the United States than in Europe; in the United States there are more than 140 species that exceed 30 feet in height, all of which I (Michaux) have examined and described; in France there are but

30 that attain this size, of which 18 enter into the composition of the forest, and 7 only are employed in building." That Michaux greatly underestimated the trees of North America is now known for there are more than 800 native tree species in the United States alone. According to a recent U. S. Forest Service publication the following genera and species of trees are native to the United States:

Tree Groups	*Number of Genera*	*Number of Species*
Hardwoods	176	695
Conifers	13	90
Palms and Yuccas	8	21
Yews and Tumions	2	4
Total	199	810

Of the 810 species, 600 species are native to the eastern, 227 species to the western United States, and 17 species occur in both the eastern and western part of our country.

C. Number of Species Vary Widely by Genera

The genus Crataegus—the Hawthorns—is credited with 178 species. This is almost three times greater than any other genus. Other genera containing a large number of species are:

Trees	*Number of Species*	*Trees*	*Number of Species*
Oaks	61	Ashes	19
Pines	35	Hickories	18
Willows	22	Maples	17

At the other extreme, are genera such as the tulip tree, the sassafras, and the osage orange with a single species each.

D. Range of Native Trees

Some native trees have a wide range, while others are limited. Among those having the widest range are a few transcontinental trees. Among these are the white spruce, common juniper, trembling aspen and white birch. The native tree with the most limited distribution is the Torrey pine. It is confined to an area of approximately 40 acres in the extreme southern part of California.

E. Native Trees Increase Southward

In the extreme northern part of the United States from 60 to 80 species of native trees occur in a single state. From 110 to 125 species occur in New York State, of which more than 50 are of commercial importance. Only six important trees are native to New York that are not found in Pennsylvania. Farther southward as many as 200 species are found in a state, and Florida has approximately 300 species, of which 100 species are tropical and occur only in this one southern state.

F. Large Number of Trees Per Acre

In the hardwood or mixed evergreen and hardwood forests of the eastern United States, such as are typical of Central New York, it is easy to find 10 to 25 different tree species per acre, and it is not difficult to see from 30 to 50 different tree species during an afternoon walk.

The forest flora of the United States is made up not only of many species but also of a large number of trees per unit of area. In a beech-birch-maple forest of northern Michigan the author counted and estimated 300,080 seedlings (one to three years old) on an acre of typical forest. With 43,560 square feet to an acre, this represents an average of about seven trees (seedlings) per square foot and each little seedling would have an average growing space of about 4x5 inches. In a seven year old stand of beech-birch-maple in northern Pennsylvania, the author counted 58,180 trees per acre. This is equivalent to an average of one and one-half trees per square foot of forest floor.

In those extensive forests that cover Norway, Sweden, Finland, and Northern Russia, only about one-half dozen native tree species of commercial importance are found. The forestry practices of Europe, known all around the world, have been developed with less than 25 important native trees. This small number of native forest trees is responsible in a considerable measure for the introduction of simple forest practices and the rapid general progress of forestry in Europe.

The tropical forests are exceptionally rich in trees. They contain thousands of kinds of known trees and many more that have not been discovered. In the Philippines, with a land area slightly less than that of the New England States and New York combined, between 2500 and 3000 different species of woody plants are now known. Dr. E. D. Merrill, Director of the New York Botanical Garden, at the dedication exercises of the Louis Marshall Building at the New York State College of Forestry, on February 23, 1933, stated that "An actual census of the arborescent vegetation on an area of about 8000 square feet (less than one-fifth of an acre) in the primary forests of Mount Mariveles, Luzon, gave the surprising total of 126 trees representing 50 different species. My judgment would be that in the entire Malay Archipelago the number of woody plants alone approximates 12,000 species."

VI. TREE IDENTIFICATION

Sufficient space is not available to consider tree identification in this outline of general forestry. Almost all of the states now have at least one special publication describing their native trees. Other general and regional tree identification publications are also available for use.

VII. OFFICIAL STATE TREES

In 1894 Rhode Island, by popular vote of the school children, selected the maple as their state tree. By this action Rhode Island became the first state to have a state tree, but the action was not official. It was a popular choice.

The first state to adopt a state tree by legislative action was Illinois. On February 21, 1908, the state legislature designated the native oak as the official state tree. Since then five other states official. It was a popular choice.

States	*State Trees*	*Year of Adoption*
Illinois	Native Oak	1908
Texas	Pecan	1919
Indiana	Tulip Tree	1931
Pennsylvania	Hemlock	1931
Georgia	Pine Tree	1935
California	Redwood	1937

VIII. MAN'S ATTITUDE TOWARDS TREES

Man's attitude towards trees has ever been changing and it is changing rapidly today. During the history of the human race the following attitudes stand out prominently:

A. An Attitude of Spiritual Reverence or Worship

Tree worship is probably one of the very earliest forms of divine ritual. Sacred trees appeared in the most ancient mythologies, and lingered in the last remnants of heathenism. No one knows how tree worship started, but records show that it was a common practice among primitive races, who believed that anything that showed signs of life must possess a soul or spirit. It is, therefore, not hard to understand that a thing so stately as a tree which grows so much bigger and becomes so much older than man, would win the adoration and reverence of early mankind. The bible from beginning to end is dotted with references to trees. At one time in the world's history it was the belief that two trees were the progenitors of the human race. Spiritual reverence for trees is not a human attitude active only in the past. It is functioning at present in Arabia, Congo Coast region, Guinea, Bengal, Philippine Islands, Bohemia, Bulgaria, Silesia, and the United States. The use of holly and mistletoe is a festive custom originated by our barbarian ancestors, who believed that they brought into the house the spirit that inhabitated them.

B. An Attitude of Fear

In medieval times the woods were believed to be the abode of evil spirits. The trees of the forests filled the medieval mind with fear. To Dante it was a dreadful thing to be lost in the woods. He

pictured the forest as a gloomy place where large-eyed owls peep out of every tree hole, where beastly bats fly about blindly, where wildcats lie in ambush at every hole, and where slimy poisonous snakes slither among the rocks and roots. And the fear of the woods is still active today. The modern child (not always under 12 years) may be fearful of big trees. This is evidence that the thoughts of the child are often akin to those of the childhood of the race. It was Tom Hood who wrote so well:

> "I remember, I remember, the fir tree dark and high;
> I used to think their slender tops were close against the sky."

C. An Attitude of Destruction

In pioneer days man's attitude towards trees was primarily one of destruction. To the pioneer, trees were obstacles in development. They were things to be gotten rid of. Then most of them had a negative value. With this attitude there developed the great era of forest exploitation and destruction.

D. An Attitude of Commercial Exploitation

In time the forest trees of this country began to have value. Their products became marketable at home and abroad. A living could be made from them, and in time, substantial profits. All these things changed man's attitude towards the trees of the forest and ushered in the era of high-pressure exploitation and salesmanship of our forest resources. This destructive attitude of commercial exploitation has not yet been outgrown, but it is being replaced rapidly by better and more forward-looking attitudes of conservation and planned use.

E. An Attitude of Conservation

Man's program of commercial exploitation could not continue for the trees of the forest would not last, nor would it be fair to future generations. A change of attitude was inevitable. The exploiters regarded the trees of the forest as the widow's inexhaustible cruse of oil. That the forests were not inexhaustible became evident to some men of vision more than 50 years ago, and all who now give serious thought to this important subject know that even to conserve our forests is not enough. What we must do is to re-think the whole forest conservation program.

F. An Attitude of Wise Planning and Use

We are just becoming aware that we must begin to develop a wise forward-looking program for the use and development of our forest resources. To withhold, preserve or reserve them is not enough. We must plan for intelligent use and development of our

forests. This requires a new attitude that will test the ability of our people to pull themselves together in a vast cooperative venture, whose purpose is the greatest good to the greatest number in the long run.

G. An Attitude of Study and Research

With the development of the attitude of conservation and wise planning and use, has come the attitude of study and research. We are now definitely aware of the fact that we do not know enough about our forest trees. The study of trees is called Dendrology. It concerns itself chiefly with gross external features, such as form, bark, leaves, buds, flowers, and fruit. Wood technology is the term commonly applied to studies of the structure and properties of wood.

To really know trees one must have a knowledge of more than the length of their trunks, the spread of their crown, the color of their bark, and the distinguishing characteristics of their twigs, buds, leaves, flowers, and fruit. Trees are much more than columns of wood that lift their crowns towards the sky. They are living creatures of a great creation, and their lives are more interesting than their structures. To say that they breathe, eat, drink, grow, reproduce, work, and rest is naming only a few of their common functions.

The three important questions that usually present themselves to a beginner of tree study are:

1. *When to study Trees?* Trees can be studied at all seasons of the year.
2. *Where to study Trees?* The best place to begin to study trees is in the forest. They can also be studied in woodlots, parks, arboretums, along streets, and on home ground.
3. *How to study Trees?* The first thing one usually wants to know about a tree is its name. Each tree has two kinds of names—the common name and the scientific name. One of our best known trees has the common name White Oak. Its scientific name is Quercus alba, *Linnaeus*. To know the common and sometimes the scientific name of trees is the first step in tree identification. The best way to study trees is among trees. Fortunate is the student who can study with a good teacher who knows trees. Trees are the subject of study not only at schools and colleges of forestry, but also at many other educational institutions. During the past few years some excellent courses in tree identification have been developed at many C.C.C. camps. Good books on trees are now available for study. It is important in the study of trees to seek good teachers and good textbooks, but foremost of all it is important to get with the trees.

H. An Attitude of Appreciation

Tree knowledge without tree appreciation is soul-less. We need more rather than less sentiment about trees. In developing a full

and true appreciation of trees it may be helpful to review some tree sentiments expressed by great men:

"Trees and rocks will teach what thou canst not hear from a master." —*St. Bernard.*

* * *

"Trees come close to our lives. They are often rooted in our richest feelings and our sweetest memories."—*Henry Van Dyke.*

* * *

"What are those pines and firs and spruces but holy hymns."

—*Oliver Wendell Holmes.*

* * *

"Trees are close to the lives of every boy and girl. No boy or girl can serve his state or nation well who does not appreciate the services of trees and understand the relation of the forest to everyday life. Trees apart from their practical value make for better manhood and womanhood by inspiring higher thoughts and cleaner ideas about life. The spiritual value of loving them and being with them is beyond counting."—*Gifford Pinchot.*

* * *

"The man who plants a tree becomes a partner with God in a creative act, for we cannot build trees, we can only preside at the mystery of their growth."

—*Glenn Frank.*

QUESTIONS

1. What is a tree? What is the difference between a tree and a shrub? Why is the tree regarded as the masterpiece of the plant world?
2. What are the three principal parts of a tree? What does a tree crown consist of? Name the principal parts of a tree stem as seen in cross-section.
3. Name the principal size classes of trees, giving the size limits of each class.
4. What are the five principal crown classes of trees? Describe each crown class.
5. How are age classes of trees usually designated? What is the age of the oldest tree in the world? How does its age compare with that of other living things?
6. What are the five main growth stages of trees? What is a seedling? Is it unusual to find more than 100,000 seedling trees on an acre of forest land?
7. How do trees grow? Discuss their increase in volume and value.
8. How do trees reproduce? Do some trees produce large quantities of seed? What happens to most of the seeds?
9. Are there many different groups and classes of trees? Name five important tree classes. What is an evergreen tree? a deciduous tree? a corner tree? a bee tree? a nurse tree? a spar tree? a wolf tree?
10. How many different species of trees are native to the United States? to your native state? How can they be grouped? How does the number of trees native to the United States compare with those native to Northern Europe? with those of the tropics?

11. Discuss the wide variation in the range of trees. What tree has the most limited range in the United States? Name four trees that have a transcontinental range.
12. Has man's attitude towards trees always been what it is today? What do you believe is the proper attitude for man to take towards the trees of the forest?
13. What is Dendrology? Where is the study of trees taught in addition to forest schools?
14. In what different ways do trees serve mankind?
15. What appreciative thoughts have great men expressed about trees?

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Author's Note: **Tree identification is not included in this General Outline of Forestry.** With at least 810 different tree species native to the United States, tree identification (dendrology) merits special consideration in a separate handbook. Many general textbooks on trees have been published. Almost every state has available for distribution books, bulletins or other publications on their local tree flora.

Liberal use of well-selected lantern slides, sketches, charts and maps is recommended for the effective presentation of this chapter.

CHAPTER V

FOREST RESOURCES OF THE WORLD

I. FORESTS ARE EVER-CHANGING

At all times throughout the world, forests have been changing. In prehistoric and in the earliest historic times, forests occupied a much larger proportion of the earth's surface than they do now. Probably, with the exception of China, the greatest change has taken place in Europe, where only one-third of the original forest area now remains. In Great Britain 95 per cent of the original forest is gone, and in Spain, Italy and Greece not more than 10 per cent of the original forest is left. In the United States the forest area has shrunk from 822,000,000 acres to 494,898,000 acres of commercial forest land in the course of three centuries, most of the change having taken place during the last century. That the forests of today are changing continuously in appearance, condition, composition, distribution, and other characteristics is clear to all who study this subject, and it is safe to predict that this process of change will continue in the future.

II. PRESENT FORESTS OF THE WORLD

The forests of the world now cover approximately 7,500,000,000 acres. This represents about one-fifth of the land surface of the earth. Much of this forest land is, however, in an unproductive condition. The productive area of forest land is only about 5,500,000,000 acres or 16 per cent of the total land surface. On the basis of this estimate, there are about three and one-fifth acres of productive forest land in the world for each inhabitant of the earth.

A. General Composition

The best available estimates of the general composition of the forests of the world follows:

Character of Forest	*Forest Area (Acres)*	*Per Cent of Total Forest Area*
Coniferous (softwoods)	2,645,000 000	35%
Temperate (hardwoods)	1,204,000,000	16
Tropical (hardwoods)	3,638,000,000	49
TOTAL	7,487,000,000	100

The foregoing table shows that almost one-half of the total forest area of the world is stocked with tropical hardwoods and that hardwoods (both temperate and tropical) comprise about 65 per cent of the total forest area. Beyond the limits of tree growth are two vegetative zones, namely, the zone of continual frost in which no vegetation exists, and the cool air zone or tundra area in which the vegetation consists chiefly of moss, lichen, heath, marsh and shrub growth.

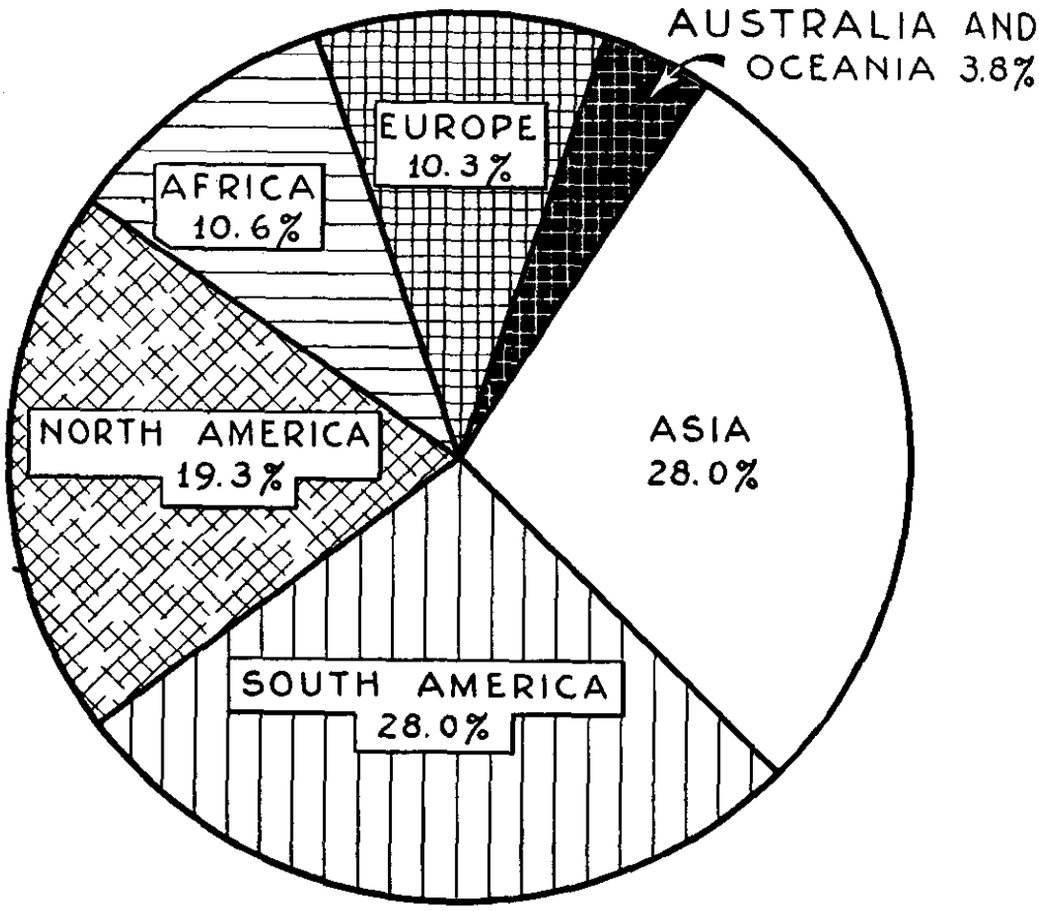

Fig. 2. Forest Areas of the World by Continents and Percents.

B. Unequal Distribution of Forest Area

That the forests of the world are unequally distributed is becoming better known. The following table gives their distribution by major continents:

Continent	*Total Forest Area (Million Acres)*	*Forest Area Per Capita (Acres)*	*Ratio of Forest Area to World's Forest Area (Per Cent)*	*Ratio of Forest to Total Area of Continent (Per Cent)*
Asia	2,096	2.4	28.0	21.6
South America	2,093	32.4	28.0	44.0
*North America	1.444	10.0	19.3	26.8
Africa	797	5.6	10.6	10.7
Europe	774	1.7	10.3	31.1
Australia and Oceania	283	34.7	3.8	15.1
World Total	7,487	4.3	100.0	22.5

* Includes Central America and West Indies.

While South America has 44 per cent and Asia has 22 per cent of its total land area in forests, it is noteworthy that South America has 32 acres of forest land per inhabitant while Asia has only about two and one-half acres per inhabitant.

A comparative study of the general forest distribution throughout the world shows that forest land is heavily concentrated in Russia, the British Empire, Brazil and the United States. These countries possess almost two-thirds of the world's forest land in the following proportions:

	Per Cent of Total Forest Land of the World
Russia (including Siberia)	21
British Empire (in six continents)	21
Brazil	14
United States and Possessions	9
	65

The remaining one-third of the forest area of the world is divided among some 50 other nations. Great Britain, France, Belgium and the Netherlands together have only about 0.4 per cent of the world's forest area in their home lands.

Approximately 95 per cent of the coniferous forests, upon which the world depends chiefly for its construction material, and 89 per cent of the temperate hardwood forests occur in the north temperate zone.

C. Variable Forest Ownership

That the character of forest ownership varies widely throughout the world is shown in the following list of countries:

Country	*Publicly Owned Forests (Per Cent)*	*Privately Owned Forests (Per Cent)*
British East Indies	100.0	0.0
Ceylon	99.2	0.8
Philippines	97.5	2.5
Greece	78.8	21.2
Australia	79.3	20.7
Switzerland	72.5	27.5
Spain	70.4	29.6
Yugo-slavia	66.6	33.4
Japan	62.3	37.7
Germany	52.0	48.0
Italy	49.7	50.3
Czechoslovakia	36.1	63.9
France	35.4	64.6
Sweden	23.6	76.4
United States*	29.3	70.7
Argentine	8.7	91.3
Great Britain and Ireland	3.6	96.4
Portugal	1.7	98.3

* Estimate of National Resources Board 1934.

It is generally accepted that forest management is at its best in countries in which a considerable portion of the forest land is in some form of public ownership. In some countries with a large proportion of public forests, however, forest management is on a very low level of performance or non-existent; in others with relatively small public ownerships, as in Sweden, forestry is highly developed.

D. Forest Area Per Capita of Population

Even more variable than the distribution of forest area from country to country is the forest area per capita of population. The following table gives the forest area per capita of population in a few representative countries:

Countries	*Forest Land Per Capita of Population (Acres)*
Italy	0.3
Germany	0.5
France	0.6
Portugal	0.9
United States	4.1
Sweden	9.0
Finland	17.0

E. World's Wood Production

According to Zon and Sparhawk, approximately 56 billion cubic feet of wood is cut each year from the forests of the world. Almost one-half of this amount is produced in North America.

F. World's Wood Consumption

The total annual wood consumption of the world is placed at approximately 56 billion cubic feet. The total wood production and consumption should be approximately equal, but may vary widely from country to country. The per capita world wood consumption is approximately 32 cubic feet and is about evenly divided between fuelwood and sawtimber. North America, with only one-twelfth of the world's population, uses almost one-half of the world's timber. The per capita consumption of timber in the United States is three to four times that of Europe.

G. World's Wood Growth

Zon and Sparhawk estimate that the total quantity of wood grown each year in the world is approximately 38 billion cubic feet. If this growth was spread evenly over the whole forest area of the world, it would amount to only about five cubic feet per acre. The best available estimates show that if all the forests of the world were given moderate protection and care, they could produce 350,000,000,000 cubic feet annually or nearly ten times as much

as at present. On the whole, it can be said that the forests of the world if handled conservatively can furnish all the timber needed for many years to come.

III. THE FORESTS OF LONG AGO

The forests of long ago differed greatly from those of today in general appearance, condition, composition and distribution. None of the tree species in our present forests were then in existence. In general appearance, the first trees resembled giant club mosses. Scientific studies show that they developed from tree ferns and cycads.

A. Conifers Came First

Of the trees that we now have, the conifers or cone-bearers were the first to develop. The ancestors of our present cone bearers (pines, spruces, firs, etc.) were at one time so abundant that this period is known as the "Age of Conifers." After the conifers came the group of trees that we now call broadleaf trees, such as the maples, ashes and hickories. These are the more modern of our trees.

B. Broadleaf Trees Gaining Ground

Among the older of our present tree groups is the sequoia of the Pacific Coast region, the bald cypress of the sunny Southland and the ginkgo of the Orient. Throughout the world today a continuous and often fierce battle is being fought between the conifers and the broadleaf trees, with the conifers on the whole losing ground and the broadleaf gaining territory.

C. Glaciers Pushed Trees Southward

To understand these great changes in tree and forest growth over these long periods of time, one must give thought to the factors that were responsible for these changes. Not so long ago (geologically) there were no Rocky Mountains or treeless prairies of the Mid-West. Then the waters of what is now the Gulf of Mexico and the Arctic Ocean mingled in a great inland sea. At one time tropical forests extended to Alaska and figs and palms grew far to the North. Then came the glacial period and with it the warm climate disappeared. The great ice sheets from the North repeatedly pushed the trees farther and farther towards the South, and in this process many tree species were exterminated completely. The glacial period was not only a great modifier and exterminator of tree species but also a destroyer of other associated forms of forest life, such as mosses, ferns, insects and reptiles.

D. Regaining Lost Ground

Since the glacial period, trees and forests have been moving slowly backward towards the North. The Christmas holly is a good example of a tree that has been regaining some of the ground lost during the glacial period. In general, it can be said that the trees and forests of today are only one stage in the progressive development of the tree and forest growth that started millions of years ago under conditions very different from those of today.

QUESTIONS

1. What evidence is there that forests have been changing through all periods of the earth's development?
2. What portion of the earth's surface is classified as forest? Are forests distributed equally or unequally throughout the world? What four countries contain most of the world's forests?
3. How variable is forest ownership from country to country? In what countries is public ownership of forests greater than private ownership?
4. Are hardwood or coniferous forests commonest in the world?
5. Discuss the world's wood production, wood consumption and wood growth.
6. What are some of the outstanding characteristics of the forests of long ago? Compare them with those of today.
7. Did the conifers or broadleaf trees appear first in the forest? Which group is now losing ground?
8. How did the glacial period affect forest distribution and tree growth?

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CHAPTER VI

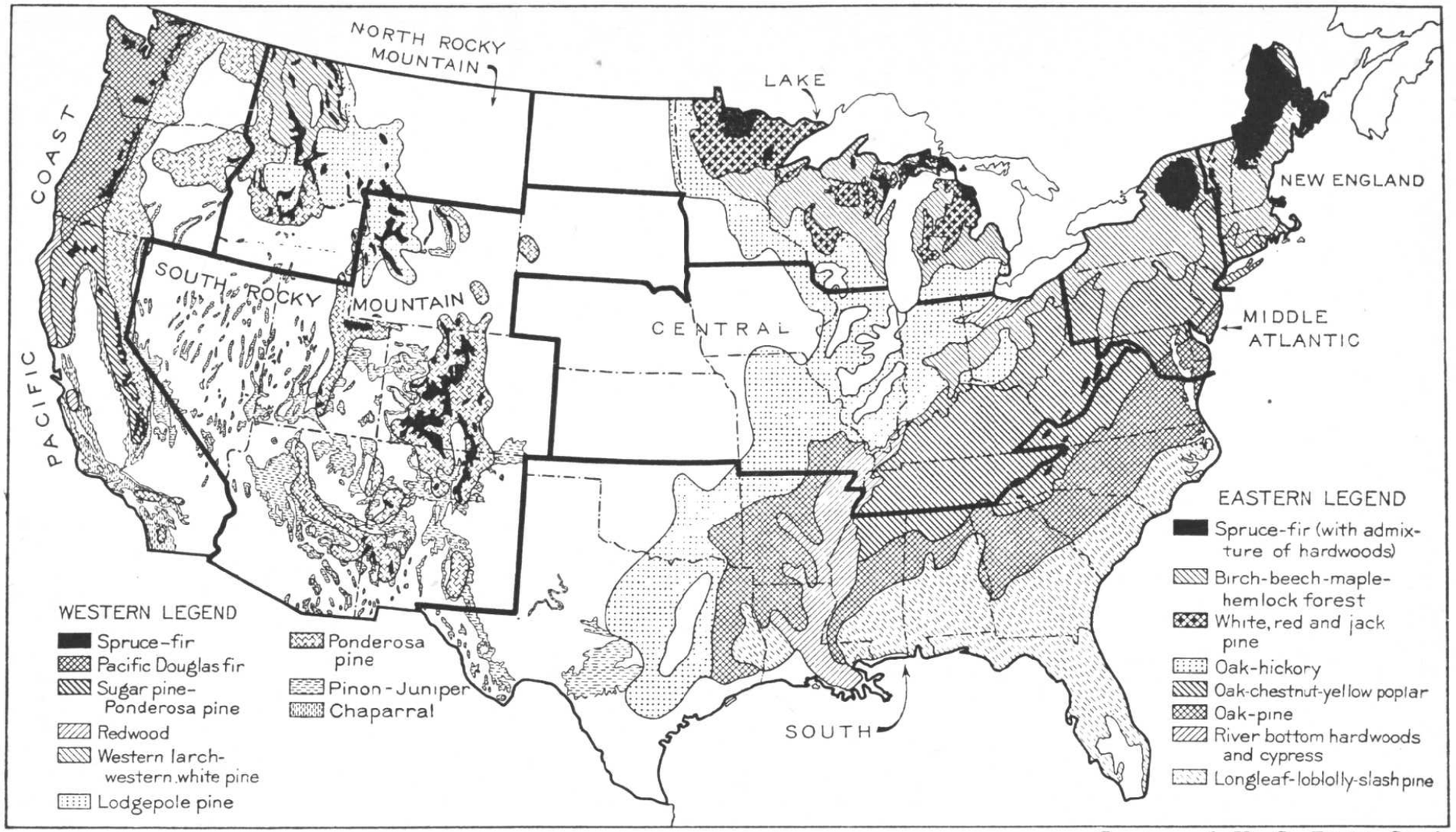
GENERAL FOREST SITUATION IN UNITED STATES

I. THE ORIGINAL FORESTS

When Columbus came to the New World, most of what is now the United States was covered with enormous stretches of dense forests. They extended practically unbroken from the Atlantic Coast to the prairies of the Mid-west. West of the great plains the forests started again, covering large portions of the Rocky Mountains down to the edge of the vast desert regions of the southwest and on the Pacific Coast there was a broad strip of as magnificent a forest growth as ever grew in the world.

The total area of the original forests of the United States was approximately 822 million acres, or nearly one-half of the total land area of our country. The amount of timber in this great sylvan realm probably far exceeded the estimate of 5,200,000,000,000 board feet made some years ago. The original forests of our country were remarkable not only for their vast extent, but also for the great number and variety of valuable trees found in them and the enormous quantities of serviceable timber that they yielded for the use of man. Nature, working for many centuries, produced trees of enormous size and great age. This vast storehouse of timber furnished the early settlers with the choicest kind of homebuilding material and later made possible the development of the great American lumber industry.

Of the 820,000,000 acres of original forests in this country, there now remain approximately 99,000,000 acres stocked with old-growth trees. Most of the old-growth forests that are now left occur on the Pacific Coast with a considerable acreage also in the Rocky Mountain regions and in the South, and very limited and widely scattered areas in the East and the Lake States. Clearing of land for agriculture and other developments was the largest single factor in reducing the original 820,000,000 acres of comparable forest land to the 495,000,000 acres now available for commercial timber growing. Lumbering and destructive forest fires also contributed strongly to forest destruction.



Courtesy of U. S. Forest Service

Fig. 3. Forest Regions and Principal Forest Types of the United States. Based on Forest Cover Map by Zon and Shantz.

II. PRESENT FOREST REGIONS AND TYPES

A. Forest Regions

The forests of the United States can be divided into a number of distinct forest regions. Eight such regions are now generally recognized by foresters. These regions have been named New England, Middle Atlantic, Lake, Central, South, North Rocky Mountain, South Rocky Mountain and Pacific Coast. Their general range and some of the forest types found within them are shown in Fig. 3.

B. Forest Types

Within each forest region occurs a wide range of forest types. According to a committee of the Society of American Foresters, forest types is "a descriptive term used to group forest stands of similar character as regards composition and development due to given physical and biological factors, by which they may be differentiated from other groups of stands." In December, 1931, another committee of the Society, after more than two years of work, suggested 97 forest types for the eastern United States. Among the recommended types from the East are:

Jack pine
Red (Norway) pine
Sugar maple—Beech—Yellow birch
White pine—Hemlock
Northern white cedar
Short-leaf pine
Short-leaf pine—Post oak
Southern cypress—Hardwoods
Overcup oak—Water hickory
Southern white cedar
Mahogany (found only in extreme southern part of Florida)
Mangrove

Some of the common forest types of the eastern and western United States are shown in Fig. 3.

C. Forest Stands

The term stand is usually applied to a given portion of a forest having a distinctive character. A committee of the Society of American Foresters defines a stand as "an aggregation of trees standing on a limited area of more or less uniformity of composition and condition or of age." The common factors which differentiate stands within a given forest type are:

1. Species or composition
2. Age and maturity
3. Density of stocking
4. System of treatment
5. Quality of site
6. Economic and social values

A few of the many different kinds of forest stands are:

1. Pure and mixed
2. Old and young
3. Even-aged and many-aged
4. Open and dense
5. Coppice and selection
6. Thinned and unthinned
7. Thrifty and defective
8. Merchantable and immature

III. PRESENT FOREST RESOURCES

A. Extent and Distribution

The total present forest area of the United States can be classified as follows:

	Area (Acres)
Commercial forest land	494,900,000
Non-commercial forest land	120,000,000*
Abandoned agricultural land, etc.	54,700,000

This total forest area comprises more than one-third of the total land area of the United States, and exceeds by 120 million acres the entire land area of the country east of the Mississippi.

The area of commercial forest land by broad timber classes, growth conditions and forest regions is given in Fig. 9.

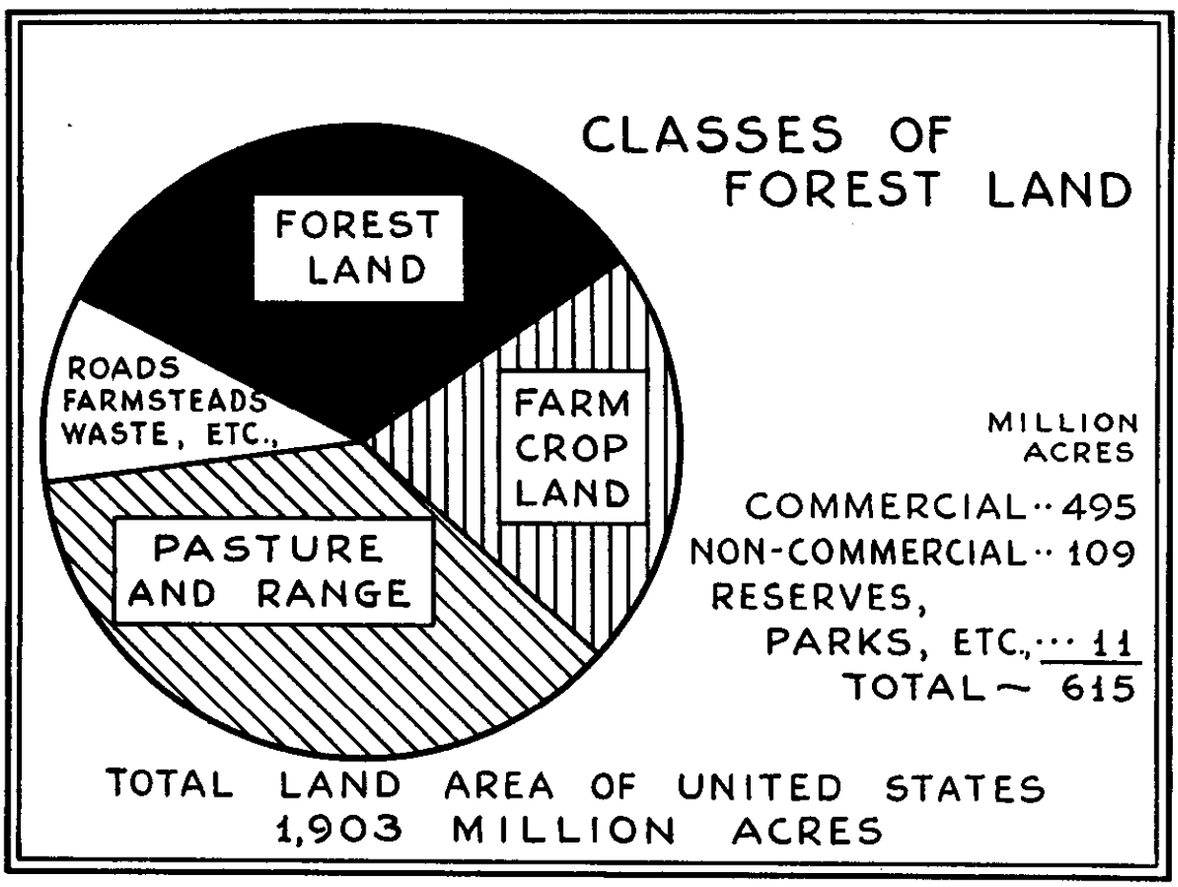


Fig. 4. Classification of Land Areas and Classes of Forest Land in the United States.

B. Composition and Condition

The composition and condition of our present forests range all the way from practically bare wastelands to extremely heavy stands of choice timber. The general make-up of the commercial forests is shown in Figs. 9 and 10.

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* Includes reserves, parks, etc.

The old growth forests are located chiefly in the West. The second growth forests are mainly in the East, with the South far in the lead. Fully 85 per cent of the restocking and non-restocking lands are found in the East. Of the 83,000,000 acres classed as poor to non-restocking, fully 34,000,000 acres are not restocking. On the whole the eastern regions have a much lower proportion of sawtimber than the western regions. The Lake States region is particularly high in non-stocking to poorly stocked forest land (fully 42,000,000 acres) and very low in sawtimber (only 5 million acres) and cordwood areas (only 9 million acres.)

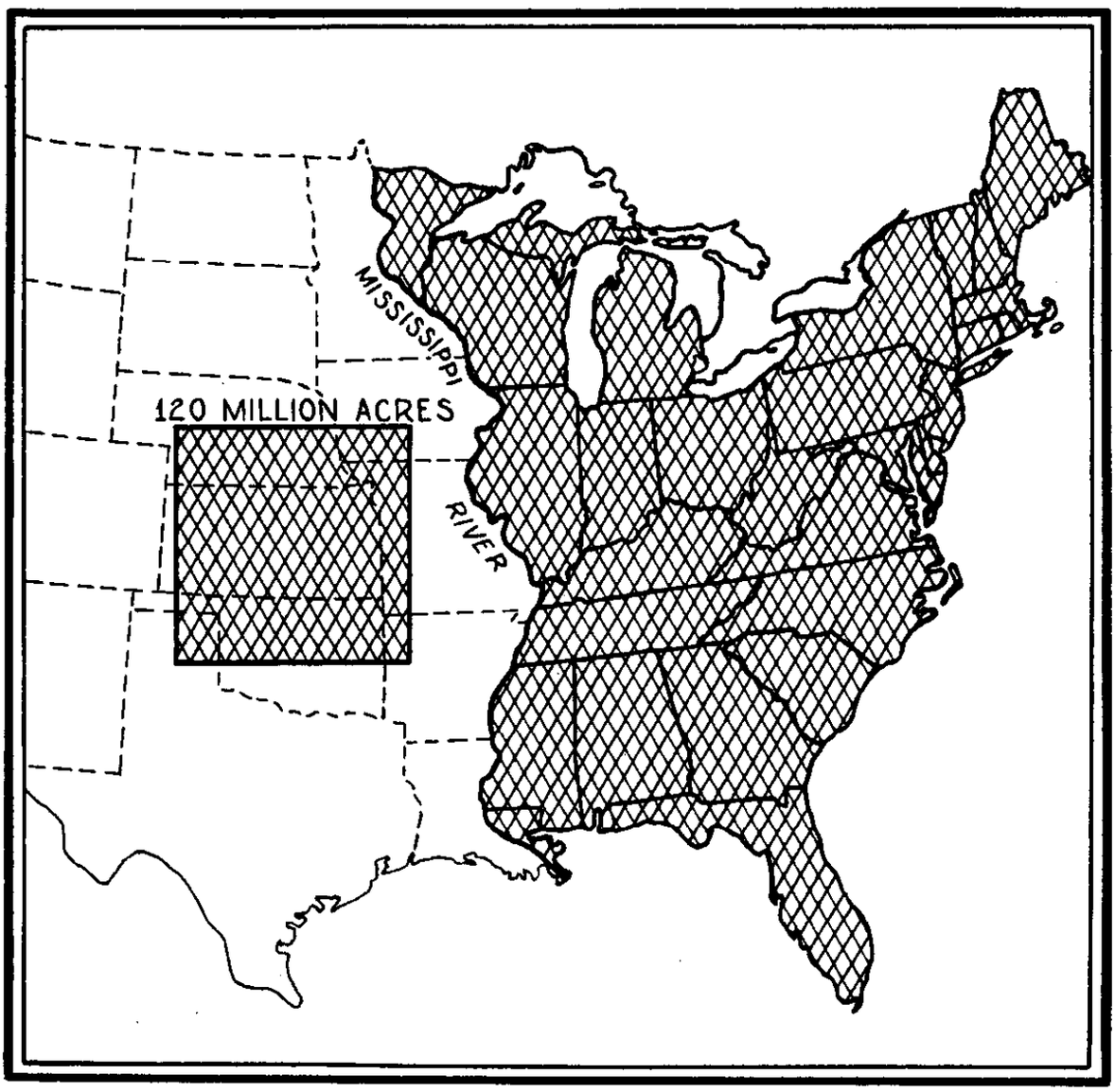
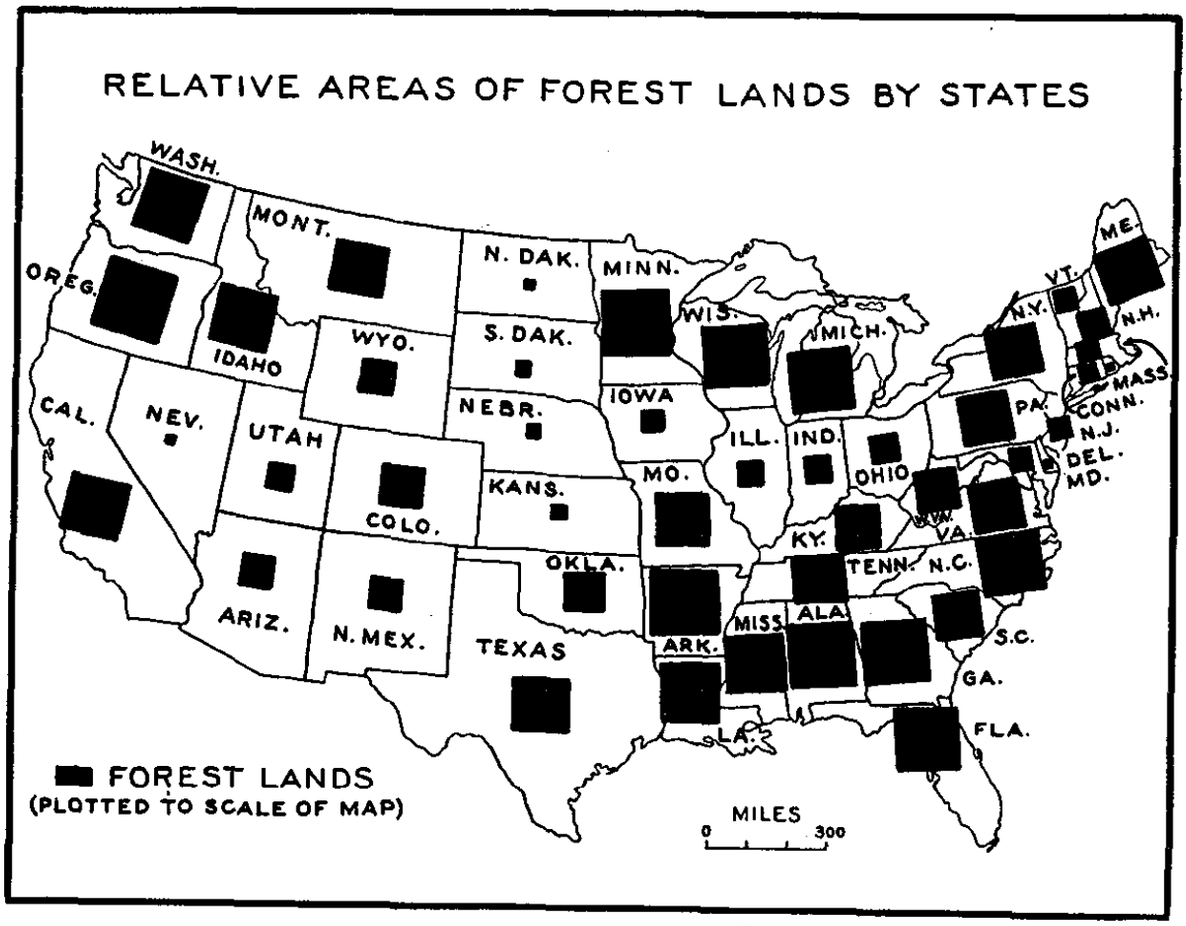


Fig. 5. The Forest Land Area of the United States Would Cover All the States East of the Mississippi With a Block of 120 Million Acres Left Over.

C. Forest Ownership

The present ownership of the commercial forests of the United States is distributed as follows:

Kind of Ownership	*Area (Acres)*
Federally owned	88,027,000
State, county and municipally owned	10,632,000
Industrial	269,516,000
Farm woodland	126,723,000
TOTAL	494,898,000 ACRES

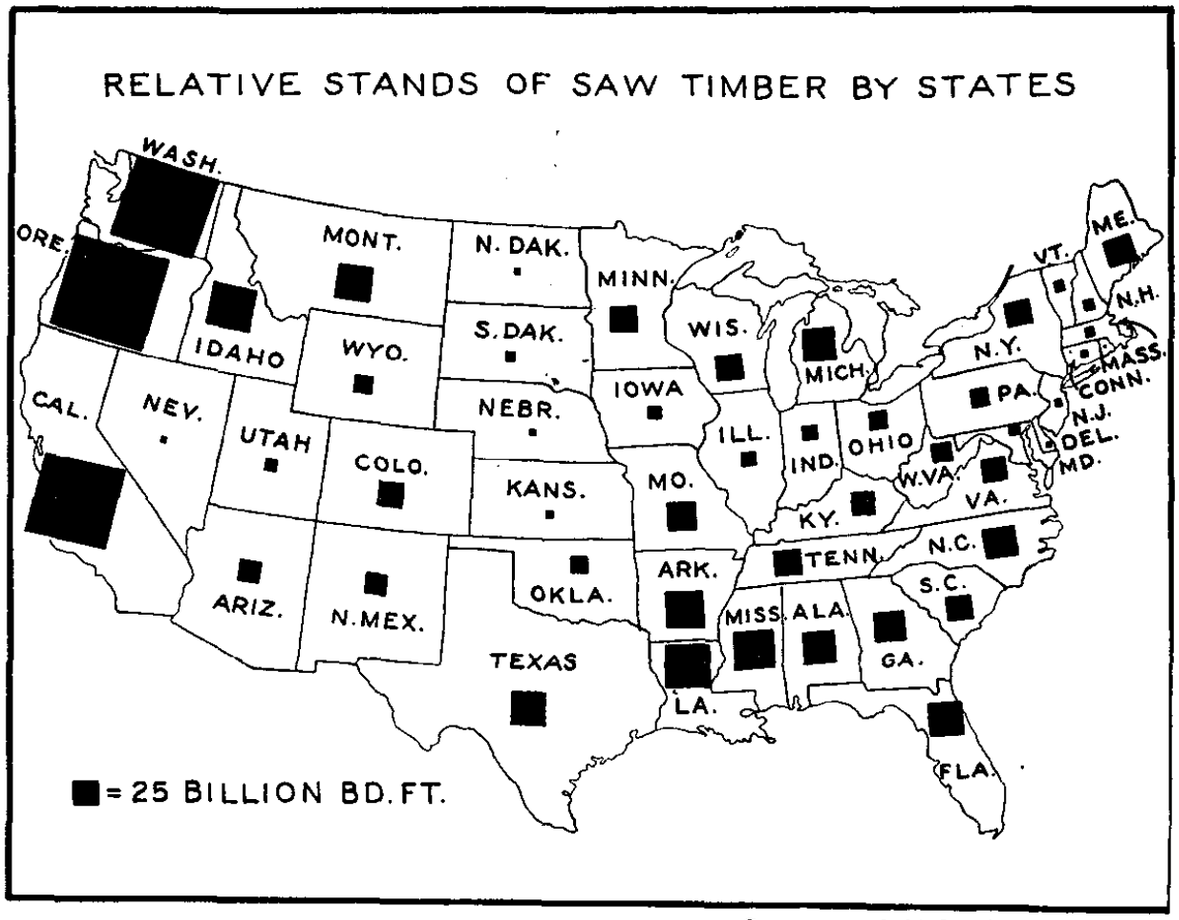


Courtesy of U.S. Forest Service.

Fig. 6. Relative Areas of Forest Land by States. Based on Estimates Published in *Timber: Mine or Crop.* The Present Area of Commercial Forest Land in the United States is Estimated at 494,898,000 Acres.

Industrial ownership of forest land is the most important kind in the United States. Well over one-half of the forest land, and by far the best, is now owned by land companies, lumber companies, paper and pulp companies, hardwood distillation companies and mining companies, naval stores operators, railroads and other private agencies. Of the industrially-owned forests 86 per cent are in the East and only 14 per cent in the West. It is, however, noteworthy that 31,000,000 acres of industrially owned poor and non-restocking forest land is located in the South. It is equally noteworthy that almost 127,000,000 acres of the country's privately owned commercial forest land is in farm woodlands, and of this, 95 per cent is located in the eastern states. Of the publicly owned commercial forest land, 88,000,000 acres is owned and managed by the federal government, 9,500,000 acres by the states, and more

than one million acres by counties, towns and other public agencies. Of the 88,000,000 acres in federal ownership 74,500,000 are in national forests, 7,500,000 in Indian reservations, and about 6,000,000 are handled by other federal agencies. Less than one-half of the total area of the national forests (172,000,000 acres) is classified as commercial forests, the remainder being classed as range lands, recreational reserves and other non-commercial areas.

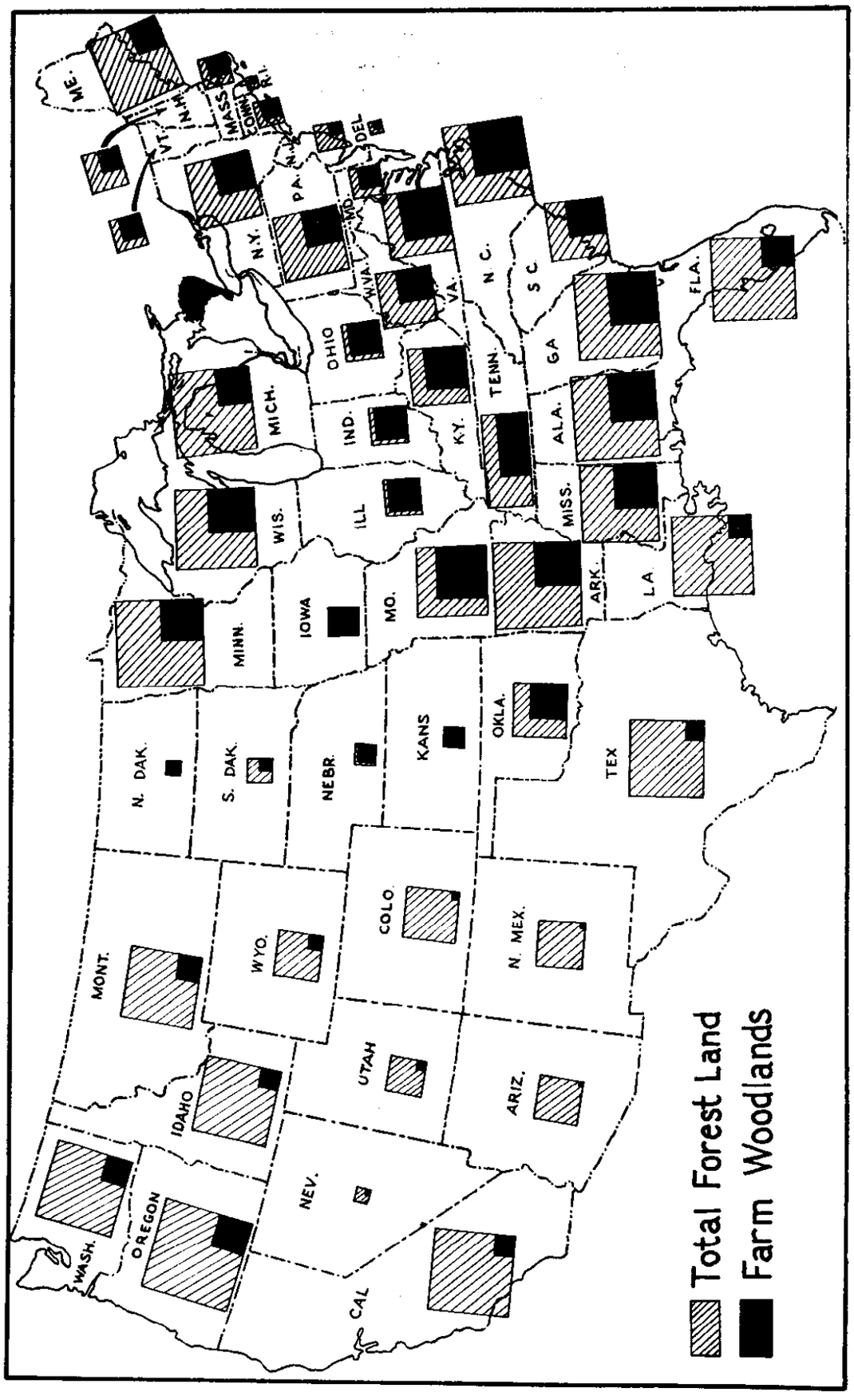


Courtesy of U.S. Forest Service.

Fig. 7. Relative Stand of Saw Timber by States. Based On Estimates Published in *Timber: Mine or Crop*. The Present Volume of Saw Timber in the United States is Estimated at 1,668 Billion Board Feet.

D. Present Timber Supply

The best available estimates of saw timber on commercial forest land in the United States is 1,668,000,000,000 board feet, of which 1,486,000,000,000 board feet are softwoods and only 182,000,000,000 hardwoods. Expressed in cubic feet—the only practical basis for comparing timber volume with growth volume—the total timber volume of the country is estimated at 487,000,000,000 cubic feet. Of the present stand of sawtimber in the United States 62% is located on the Pacific Coast, 12% in the South, 9% in the north Rocky Mountains, 8% in the south Rocky Mountains and only 2 to 3% each in the New England, Middle Atlantic, Lake and Central States. This shows that the great remaining reservoir of sawtimber is on the Pacific Coast, which has only 13% of the forest area but



Courtesy of U. S. Forest Service

Fig. 8. The Farm Woodlands of the United States by States.

62% of the sawtimber. The New England, Middle Atlantic, Central and Lake States have 35% of the total commercial forest land of the country but only 9% of the sawtimber, the South with 39% of the area has only 12%, and the West with 26% of the area has 79% of the sawtimber, and of this nine-tenths is classed as old growth.

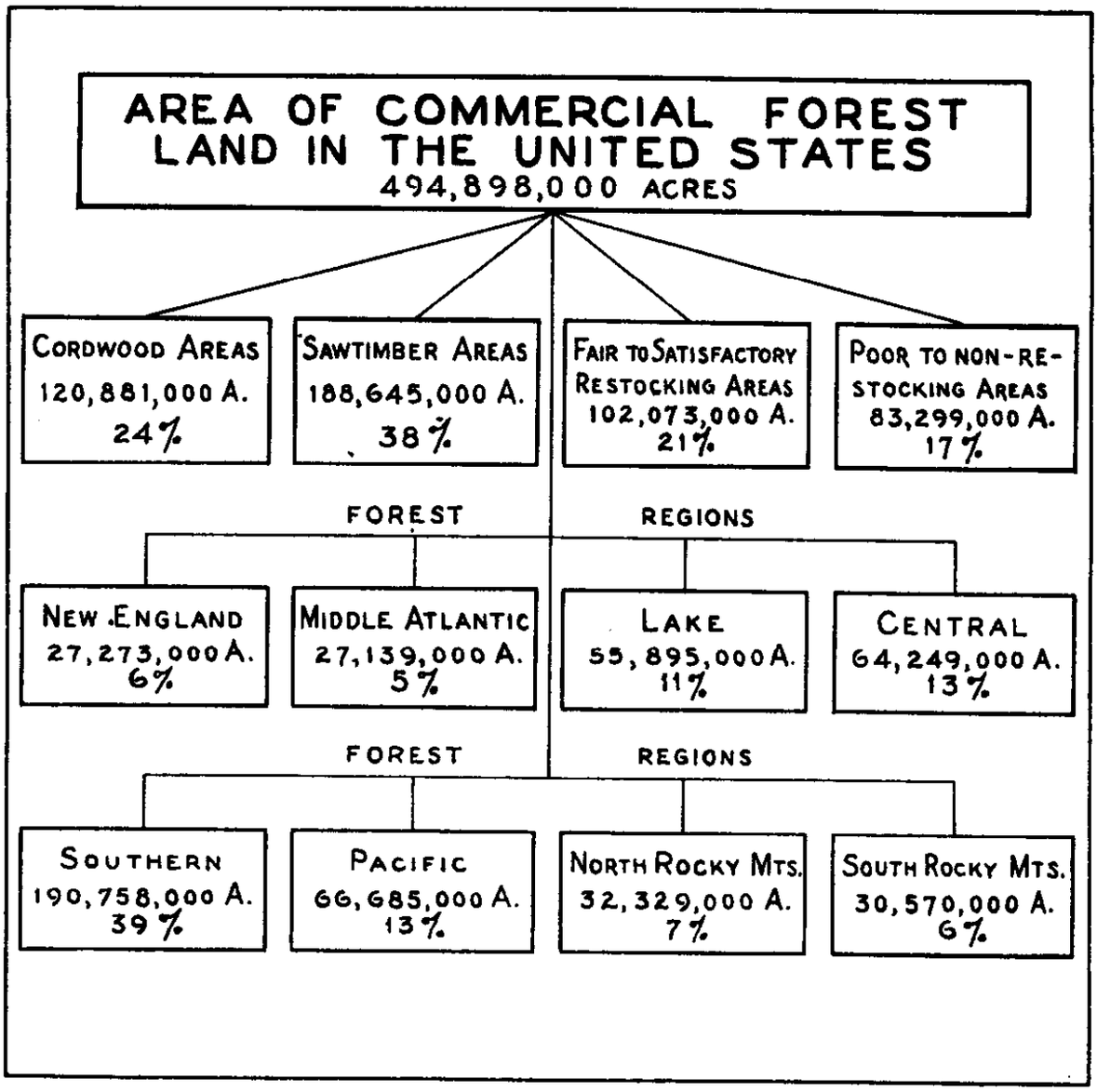


Fig. 9. Area of Commercial Forest Land in the United States by Conditions of Forest Growth and by Forest Regions.

The total volume of cordwood in the country is estimated at 2,382,000,000 cords, of which one-third is found in the Southern States.

E. Present Timber Cut

In any consideration of the general forest situation, a basic consideration is the amount of material removed from the forests annually by cuttings, by fire, insects, fungi and other destructive

agents. The best available estimate of present annual drain on the commercial forest timber in the United States is placed at somewhat more than 16,000,000,000 cubic feet, of which approximately one billion cubic feet of loss is due to fire, diseases and other destructive causes. In developing this total, the figures for timber cut are based upon the average quantity of commodities produced from domestic timber during the period 1925-1929.

F. Present Timber Growth

The best available data on the present annual growth of usable material, both sawtimber and cordwood, on the commercial forest areas of the United States, place it at 8,912,000,000 cubic feet. In 1925 to 1929 the total drain on sawtimber was about five times greater than its growth, and the drain on the total timber volume was almost twice that of the timber growth.

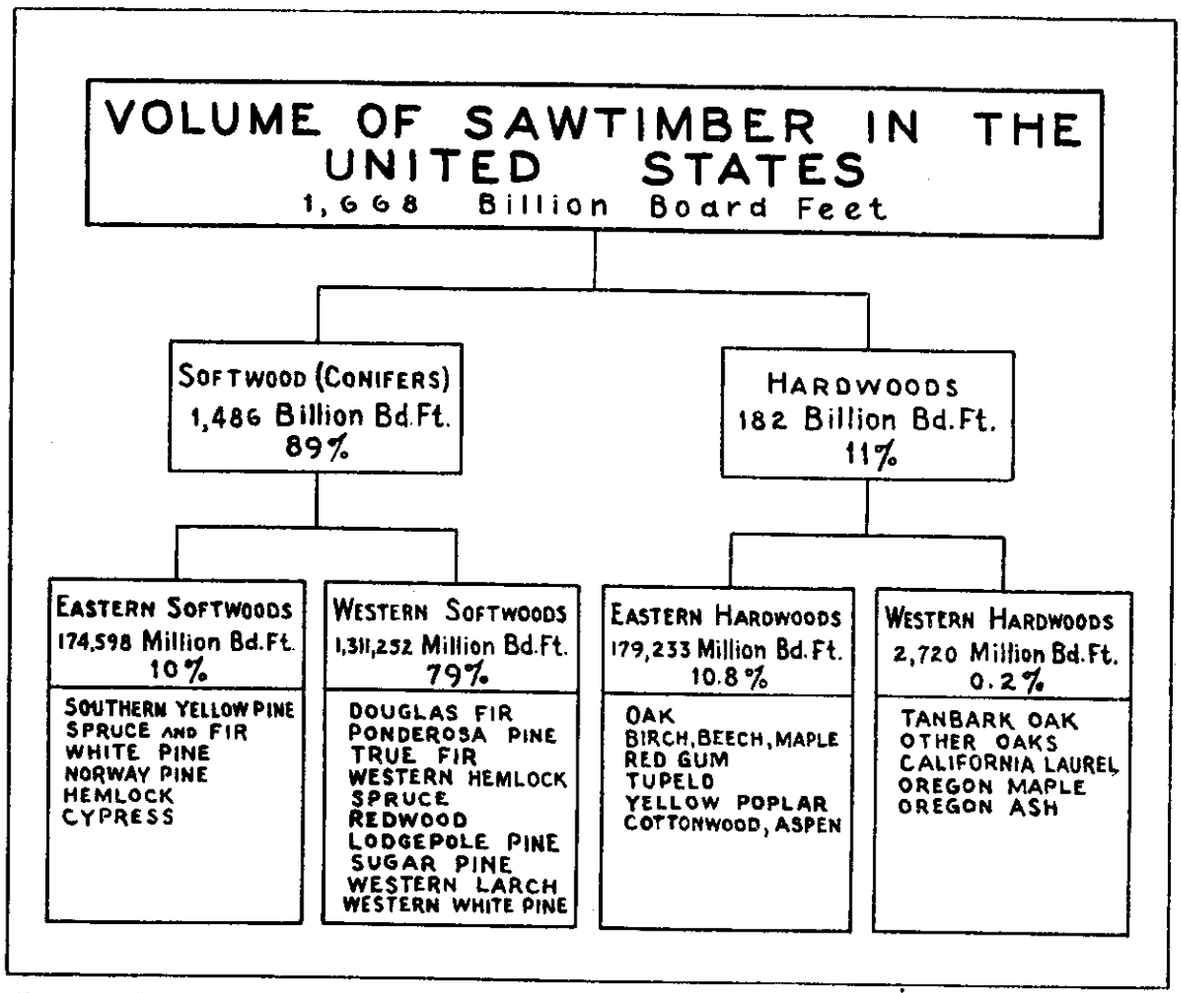


Fig. 10. Volume of Sawtimber in the United States by Classes of Wood and Regions. Lists Include Only Representative Classes of Wood. Additional Softwoods and Hardwoods Were Included in Estimate of Stand.

G. Trends of Lumber Consumption in United States

The trend of per capita lumber consumption in the United States is shown in Fig 11.

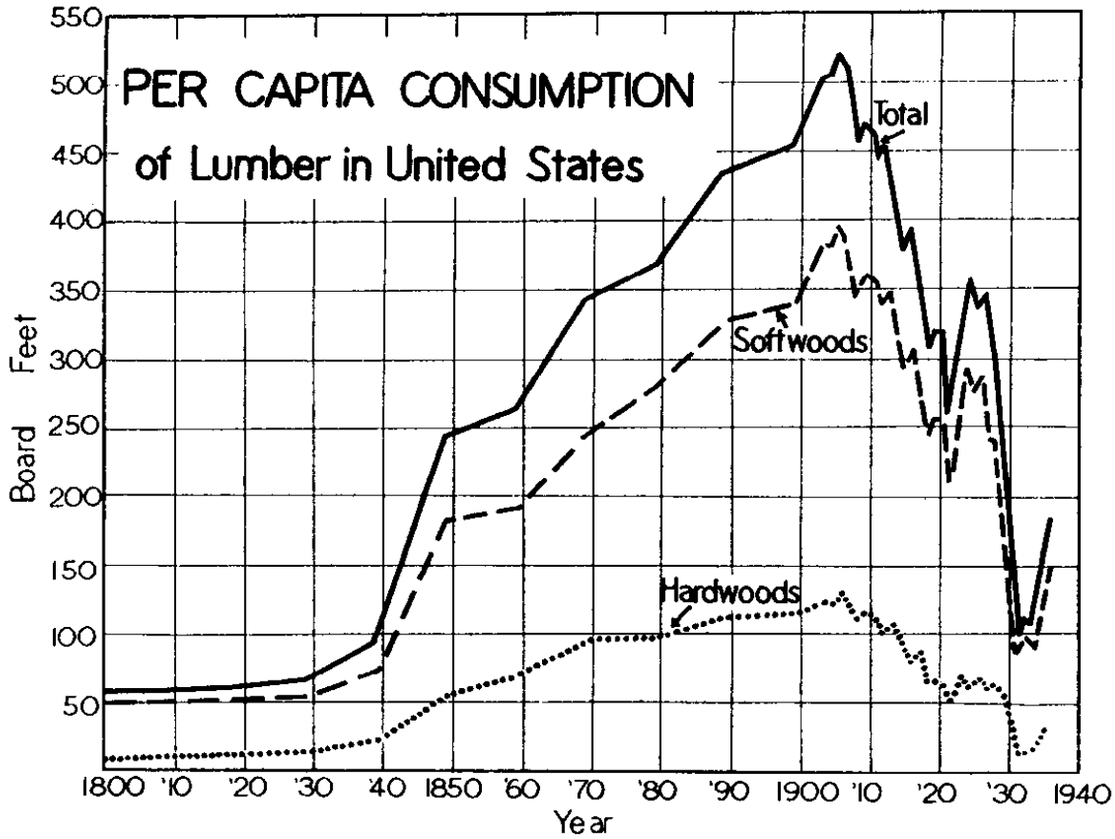


Fig. 11. Per Capita Consumption of Lumber in the United States.

H. Future Timber Requirements

Future timber requirements cannot be forecast definitely, but it is desirable that they be estimated as closely as possible. The U. S. Forest Service estimates the possible future normal timber requirements at 16,500,000,000 cubic feet.* To meet these requirements a number of plans are suggested by the Forest Service. One of them recommends the following types of management:

	Area (Acres)
Intensive forestry	70,000,000
Extensive forestry	278,900,000
Protected, relatively favorable for forestry	40,700,000
Protected, relatively unfavorable for forestry	69,700,000
Open	49,300,000
TOTAL	508,600,000 ACRES

It is believed that the five foregoing types of management will provide a sustained annual yield of 17,750,000,000 cubic feet of timber, which is approximately a billion cubic feet more than may be required—a fair margin for safety. The other plans are discussed in Copeland Report pages 241-244. A later discussion of our forest situation is found in the 1937 report of the Chief of the U. S. Forest

* For full explanation of this estimate and other statements on present and prospective timber requirements see Copeland Report, pages 236 and 237.

Service under the title of "Our Forest Lands." This report is reviewed by John B. Woods in the March 1938 issue of the Journal of Forestry. In the spring of 1938 a joint Committee on Forestry was appointed by the House of Representatives and the Senate of the United States for the purpose of studying and reporting on the forest problems of the nation. This report should bring the forest situation up-to-date. It is predicted that results of recent studies will reveal substantial differences from earlier statistical reports.

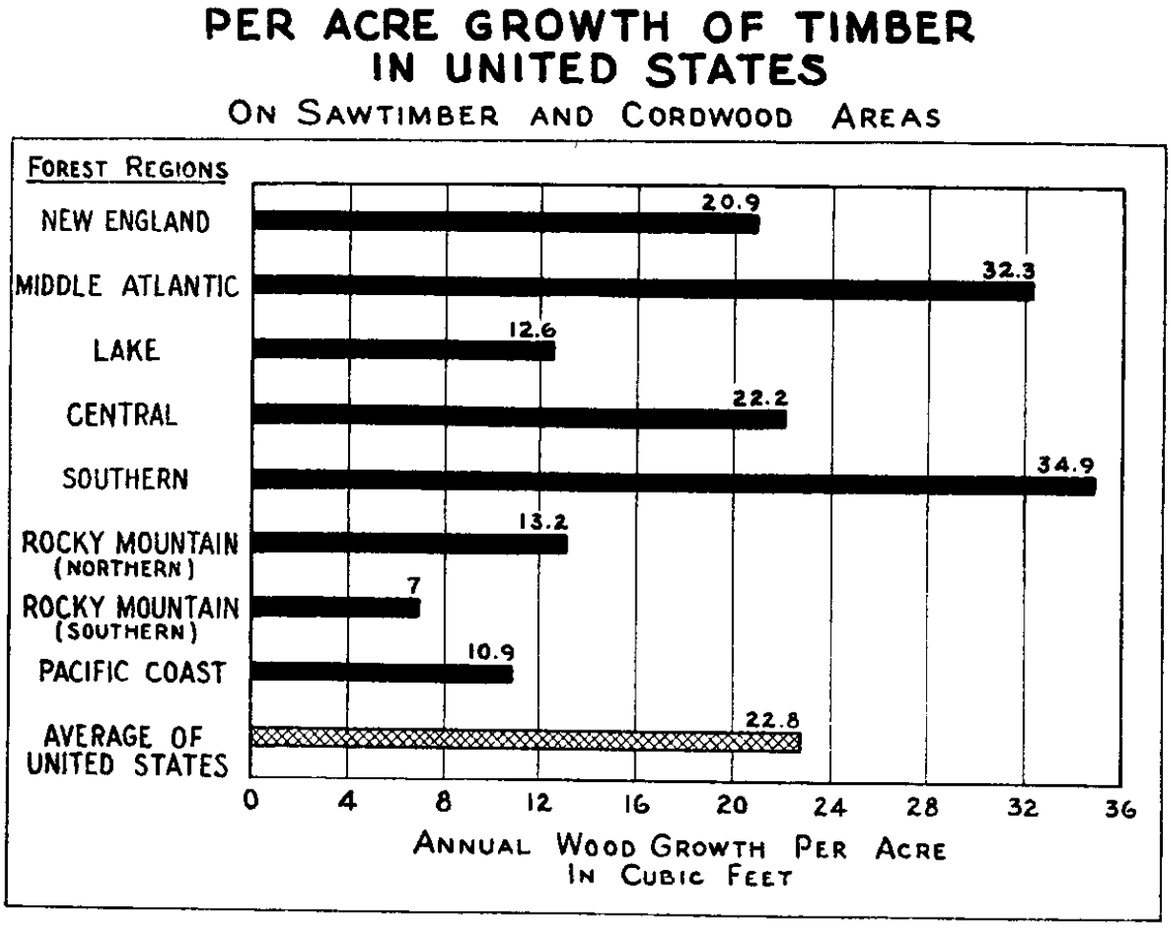


Fig. 12. Annual Wood Growth Per Acre on Sawtimber and Cordwood Areas of the United States.

QUESTIONS

1. What proportion of the land area of the United States did the original forests cover? What are the principal characteristics of original forests?
2. How much forest land is left in the United States and how is it distributed?
3. Name the eight forest regions of this country and describe briefly several forest types in each region.
4. What is a forest type? a forest stand? What factors are responsible for stand differences? Name some representative kinds of forest stands.
5. Discuss the general composition and conditions of the forests of the United States.
6. How is the ownership of the forests of this country distributed?

7. Discuss the present timber supply, timber cut, and timber growth in the United States.
8. What trends have developed in total and per capita lumber consumption in the United States?
9. How can the future timber requirements of this country be met? Is a plan of sustained annual timber yield needed to guarantee these requirements?

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Chapter VII

DEVELOPMENT OF THE AMERICAN LUMBER INDUSTRY

I. EARLY HISTORY OF LUMBERING

In the early days of our nation, vast areas of forests were destroyed to establish homes and to open fields for crop production. Beyond these home needs, there developed early an opportunity to sell some forest products. These commercial opportunities for the cutting and sale of forest products developed so rapidly and reached such large proportions that it soon resulted in a flourishing business that in time became the great American Lumber Industry.

A. First Lumber Made by Hand Labor

At first the manufacture of boards, planks, beams, and other usable forms of wood was entirely a matter of hand labor with axe, saw, sledge, and wedge. Then, all lumber was hewn or hand sawed. The first sawmill built in Rensselaer County, New York, had "no tools but an axe, a saw and an augur." After the development of the two-man saw, pit-sawing came into use. In this method, the log was raised over a pit or placed on high wood horses with one sawyer standing on or above the log and the other underneath. Pit-sawing continued until as late as 1860 in Steuben County, New York.

B. Early Sawmills

It is now generally accepted that the first sawmill in America was established at Jamestown, Virginia in 1625, and that the first commercial sawmill was placed in operation at Berwick, Maine, in 1631. The Dutch also erected sawmills in the early days of their Manhattan settlement and in 1654 a sawmill was already operating at Albany. The machinery for these early sawmills was imported from Holland, and all the mills were driven by water power or by wind mills. The output of these early mills was small. For almost 100 years few, if any, mills had a capacity of five thousand board feet per day. The discovery of the steam engine was a great boon to the lumber industry. It is reported that the first steam sawmill in this country, erected in New Orleans in 1811, was promptly destroyed by a mob of angry laborers who assumed they would be thrown out of work by the application of steam power to the saws.

C. New England Most Active

New England was most active in lumbering in the early days. While Virginia was settled before New England, the settlers of the former colony were engaged chiefly in agriculture. New England early became the center of the ship-building industry, and with its growth there developed a strong demand for straight pine for ship masts and sturdy oaks for hulls.

D. Foreign Lumber Shipments

As early as 1626, the colonists sent some lumber to Holland, and from there it was re-shipped to England. For many years the timbers of the finest ships in the British Navy came from New England. It is noteworthy that sawmills were operated in the American colonies more than 100 years before they were established in England. It was not until some time after 1768 that England had her first sawmill.

E. The Beginning of a Big Industry

It was not until about 1840 that lumbering began in the United States in a big way. Up to that time lumber was used chiefly to satisfy local home use and for export. With the development of the Mid-West, lumbering began on a large scale. The Prairie or Plains states were without sufficient timber, if indeed they had any at all. An extra heavy demand for lumber gave a powerful impetus to the industry. The first census giving the number of sawmills with considerable accuracy was issued in 1840. It recorded a total of 31,650 sawmills in the United States, of which 6,356 were in New York and 5,389 in Pennsylvania, or more than one-third of the total in the country in these two states.

II. LUMBER INDUSTRY SHIFTED CONTINUOUSLY

The lumber industry began operating first in New England, then the Middle Atlantic States, followed by the Lake States, then the South, and finally the Rocky Mountain and Pacific Coast regions.

A. Lumbering Began in Maine

Until 1850 Maine, *The Pine Tree State,* led all other states in lumber production. That year (1850) New York took the lead and in 1860 Pennsylvania won first place. Shortly before 1870 the Lake States took first place and reached their peak of production in 1892, with a total cut of nearly 9,000,000,000 feet. Between 1900 and 1910 the Southern Pine region superseded the Lake States as the leaders in lumber production, but no extensive lumbering development took place in the South before the seventies. It was not until about 1875 that there was a considerable market for south-

ern pine north of the Ohio River. The peak of southern pine production was reached in 1909 with an output of almost 17,000,000,000 board feet.

B. Shifts from the South to the West

The lumber industry in the far west started in the early fifties. The first sawmill on Puget Sound began operating in 1845. From then to the end of the century lumbering was largely of a local character. The completion of the Northern Pacific Railroad in 1882, the granting of lower lumber freight rates to eastern markets in 1894, and the opening of the Panama Canal, all helped to stimulate the lumber industry on the Pacific Coast. Washington became the leading state in lumber production in 1905, and has held this place every year since, with the exception of 1914, when Louisiana was in the lead.

PERCENTAGE OF LUMBER PRODUCED BY REGIONS

Region	*1850*	*1890*	*1909*	*1919*	*1929*	*1935*
Northeast	54.8%	19.8%	11.8%	7.5%	3.3%	3.9%
Central	18.6	13.1	12.3	8.7	6.4	5.1
Lake States	6.3	34.6*	12.3	7.8	4.8	4.1
Southern	13.6	20.3	44.8*	46.6*	41.9	40.1
Western	5.9	9.6	18.4	29.2	43.4*	46.6*
All Others	.8	2.6	.4	.2	.2	.2

The western states now produce nearly 50% of the lumber supply of the United States. A half century ago they produced less than 10%. Three-quarters of a century ago the northeastern states produced more than 50% of the lumber supply. Now they produce less than 4%. The southern states now supply more than 40%; a half century ago their production was only about 10%. Such have been the shifts in the main sources of our lumber supply.

III. LUMBER INDUSTRY REACHES ENORMOUS SIZE

From a small beginning in colonial days, the lumber industry has developed into one of the leading industries of our nation. It is an industry of substantial proportions in 38 states. Of the 20 leading industries, not including agriculture or the railroads, the lumber industry in 1930 ranked second in the number of persons employed, third in the extent of its investments and eighth in the value of its products. The lumber and secondary woodworking industries of the United States represent approximately $10,000,000,000 of capital, $3,600,000,000 in value of annual products, and 1,000,000 in number of employees. According to the 1929 census the Lumber and Timber Products Industry employed 419,084 wage earners, paid out a total of $421,585,000 in wages, and produced products valued at $1,273,472,320.

* The leading lumber producing region.

A. Trend of Lumber Production

The trend of total lumber production in the United States is shown in the following table.

Year	Lumber Production (Thousand Board Feet)	Year	Lumber Production (Thousand Board Feet)
1868	12,756,000	1932	10,151,000
1899	35,084,000	1933	13,961,000
1909	44,510,000	1934	15,494,000
1929	36,886,000	1935	19,539,000
1930	26,051,000	1936	24,355,000
1931	16.523,000	1937	24,650,000

B. The Peak Year in 1907

The peak year in lumber production in the United States was in 1907, when more than 45,000,000,000 board feet were produced by approximately 44,000 sawmills. In 1909 there were 19 states that each cut more than one billion board feet of lumber. In 1892 the Lake states reached a maximum production of 8,500,000,000 board feet of white pine. The South reached its peak of 20,000,000,000 board feet abut 1909, at which time it was supplying almost one-half the lumber cut of the entire country. Since that time the lumber cut of the South has slowly fallen off, and now it is less than 8,000,000,000 board feet. During the past ten years the West has been gaining in lumber production. Now the West produces almost one-half of the total lumber production of the United States.

C. Big Log Booms and Sawmills

A few facts about early log booms and modern sawmills should be helpful in understanding the size of the lumber industry when approaching the peak of production. In 1849 the Hudson River Boom Association built a big sorting boom at Glens Falls, N. Y. In 1872 it reached its maximum capacity with 2,000,000 logs scaling a total of 213,800,000 board feet, or about 106 board feet per average log. The Susquehanna Boom Company was organized at Williamsport, Pa. in 1846. A flood of 1860 destroyed the boom. It was rebuilt several times. In June, 1889, the largest flood was recorded and caused the water to rise 33 feet and 9 inches above the low water mark and carried away 300,000,000 board feet of logs, many of which reached the Chesapeake Bay. From 1862 to 1898 the boom held 38,993,470 logs, or 6,407,084,182 board feet, an average of 165 board feet per log. During the height of southern pine operations a sawmill at Bogalusa, Louisiana, had a daily cut of over one million board feet. This record cut was held for some years until a larger mill was placed in operation by the Long Bell Lumber Company at Longview, Washington.

IV. GREAT CHANGE IN LUMBERING METHODS

Great changes have taken place in lumbering methods during the 300 years that the lumber industry has been in operation in the United States. These changes can be seen in tools, logging equipment, transportation methods, cutting and conversion methods, types of sawmills, as well as the methods of storing, seasoning and merchandising lumber.

A. Early Gristmills and Sawmills Combined

Many of the early sawmills were combined with grist mills. These early sawmills were usually erected near or amidst heavy stands of timber. When the timber supply gave out the mill was moved to a new supply. Oxen were used chiefly to bring the logs to the mill.

B. Log Driving, Rafting and Fluming

Quite early lumbermen began to transport logs by water (driving, floating, splashing, and later rafting and fluming). Log driving began in New York about 1813. Rafting continued in use until about 1880. To facilitate the handling of logs in larger bodies of water and to determine ownership, log marks were designed and used. Each lumberman had his own distinctive mark. In time it became necessary to register these log marks. In 1851 a law was passed requiring the registering of all log marks used on the Racquette River in the Adirondacks. The last entry, made on Dec. 4, 1900, gave a total of 102 different marks on this one river.

Enormous losses in log driving caused the lumbermen to build their logs in rafts. Usually the rafts were floated downstream with the current while on larger rivers and lakes they were convoyed by tugboats. As early as 1884, the ocean was braved with a huge log raft. Ocean-going rafts have been operated rather extensively from Portland, Oregon to San Diego, California. Some of these rafts are bigger than ocean liners. They are up to 835 feet in length, 55 feet wide, draw from 25 to 30 feet of water, and contain at least 5,000,000 board feet of timber. During the past 30 years more than 100 of these ocean-going rafts have left the Columbia River and all but two of them reached their destination in safety.

Fluming is another method of water transportation rather popular on the Pacific slopes. The flume is a V-shaped or rectangular wooden trough in which artificial streams of water carry the logs, billets, or lumber downhill to lower places. The length of the flumes ranges from a short distance of several miles or less to a distance of 25 miles or more.

C. Circular and Band Saws

The invention of the circular and band saws effected great changes in lumbering methods. Benjamin Cummings, born at Bentonville, New York, is credited with being the first American inventor to make a circular saw. He hammered out his first saw in his backsmith shop in 1814. About 1840, circular saws appeared, into which *false teeth* could be fitted. Among the outstanding sensations of the Centennial Exhibition in Philadelphia in 1876 was a band saw in swift operation. It had been perfected by Henry Disston, the founder of the now well-known saw firm. From that historic event dates the introduction of the band saw in American sawmills. There has been keen rivalry between the circular and the band saw. The common circular saw is fifty-four inches in diameter and is the more popular in small portable mills while the band saw has a front place in big mills. In the seventies a six-inch band saw was considered remarkable, but now 18-inch ones are common and they often are up to 60 feet in length. They travel at a rate of about one and a half miles a minute, and many of them are double-cutting, that is, have cutting teeth on both edges of the blade. These modern saws stand in strong contrast with the *Up-and-Down* single blade frame saws of the early days usually with a capacity of less than five hundred board feet per day.

D. Railroad Logging

The first logging railroad in New York was built in Steuben County in 1851. Railroad logging was introduced on a large scale in the forests of Michigan shortly after the Centennial Exhibition in Philadelphia in 1876 where the plan was conceived. Five years after the first logging railroad was completed in Michigan there were 71 logging railroads in operation in that state alone and five in Wisconsin. At one time there were more than 30,000 miles of logging railroads in the United States. The use of logging railroads completely changed the earlier lumbering methods. They made possible the lumbering of areas that could not be reached from waterways and also made possible the harvesting of hardwoods that could not be floated.

E. Modern Logging Methods

The horse and the ox have almost disappeared from the modern logging scenes. Practically all logging operations except for the felling of the trees, which is still nearly all hand work with axe and saw, is now carried on almost entirely by machinery. Cable logging, truck and tractor transportation, stationary and portable engines, steam, gasoline and electric locomotives are now the rule. Modern logging is entirely different from that of the early days

and even from that of several decades ago. Present day logging is, however, being modified somewhat to give more consideration to the renewal of forest crops and to the handling of forests on a sustained yield basis.

V. RAPID DECLINE OF LUMBER INDUSTRY

The decline of the lumber industry in many localities has been even more rapid than its rise. The rise and fall of lumber towns is among the outstanding economic and social tragedies of our country. These tragedies can be understood better by considering the rise and fall of a few typical lumber towns.

A. The Rise and Fall of Leetonia

As late as 1870 only two families lived on the site that later became the busy lumbering town of Leetonia, Pennsylvania. In 1879 a tannery was established with an annual capacity of 3,000 cords of hemlock bark. Almost overnight this settlement of two families grew to a town of 200 people. In 1882 a railroad came to the town and a sawmill with a band saw was erected in 1897. This mill was operated continuously until 1913, when it was replaced by a larger and better mill with a daily capacity of 100,000 board feet of lumber. As many as 10,000,000 board feet of white pine were taken out of the forest about Leetonia in a single season. Other trees, such as beech, birch and maple had no value and only the bark of the hemlock was used. In those days the choicest white pine logs brought only from $3.00 to $3.50 per thousand board feet.

Leetonia was at its best from 1913 to 1917. Then the town had a population of 500 with many more men at work in the woods cutting logs and peeling bark. In 1917 it became evident that the town was doomed for the supply of wood and bark was beginning to give out. In the early winter of 1920 the bark supply was exhausted completely and the tannery which had been in operation for more than 40 years—to be exact since 1879—was closed down and in 1921 the last log was cut at the sawmill. The closing down of the tannery and sawmill was the next to the last chapter of the town's existence, and what appeared to be the last chapter was the sale of the whole town of 70 houses, including the tannery and sawmill buildings and 400 acres of land for $6,500—the price of one modest city home.

There was only one thing left for the people to do and that was to get out of town. This they did in a hurry for in the fall of 1922—one year after the sawmill shut down—only four families remained. Three of these four families moved out in the spring of 1923. This left only one family. One wonders why this one

family remained at Leetonia. The answer is indeed interesting and very significant. The head of this one remaining family was appointed State Forest Ranger. With him began the rebuilding of the forest about Leetonia. It has again become an active village with a forest ranger and a forest inspector and their families, numerous forest workers, several hundred hunters and fishermen in season, and a civilian conservation corps camp with 200 young men with their supervisory personnel of superintendent, foresters and foremen.

B. The Short Life of Norwich

For a short time the town of Norwich held a commanding place in the lumber industry of Pennsylvania. As late as 1909 the entire town site was covered with a dense stand of big hemlock trees. Late that spring, tree felling and bark peeling began. Then followed other lumbering activities, and the erection of a sawmill, stave mill, and hardwood distillation plant. By 1912 Norwich was a busy town of 2000 people. In addition to the town there were many workmen living in camps, shacks, and shanties throughout the nearby forest holdings of 300,000 acres. To supply the sawmill and other wood-using industries with raw material was a big job for the sawmill alone had a daily capacity of 300,000 board feet. Over 100 miles of logging railroads were required to bring the logs and wood to the plant. When at its best, Norwich was a busy place. In a single year it turned out more than 90,000,000 board feet of lumber.

When lumbering operations started at Norwich many thought the timber supply on the 300,000 acres was practically inexhaustible. The most conservative estimates predicted a supply for at least 25 or 50 years. But all these predictions were wrong, for as early as 1917 it became evident that the town was doomed. It could not last much longer. The active life of Norwich was less than ten years for the sawmill that started in the fall of 1912 closed on August 20, 1921. In the fall of 1922 less than 20 families remained. All of the remaining workmen were engaged in dismantling the mill, tearing down houses, and lifting railroad tracks. A year later, little was left about Norwich except bare and burned hillsides exploited of their valuable forest growth, the foundations of former buildings, empty shacks and shanties and abandoned logging roads. No trees of merchantable size were left. Vast areas were left without any tree growth. On other areas there was a thin sprinkling of growth much of it made up of inferior sprouts, seedlings and saplings. There was no provision for forest renewal on any one of the 300,000 acres. There is, however, a measure of satisfaction in

the fact that the Commonwealth of Pennsylvania has purchased a considerable portion of this tract and is now administering it as a State Game Refuge.

Hundreds of lumbering towns in New York, the Lake States, and the South have had histories fully as tragic as those of Leetonia and Norwich. They grew too fast to fashion a permanent pattern. Their rise was rapid and their fall even speedier. The most they left was evidence of excessive forest exploitation.

VI. PERIOD OF VIGOROUS COMPETITION

Twenty-five years ago the use of lumber was at its peak. Since then there has been a rapid decline. In 1907 the per capita consumption of lumber in the United States was about 500 board feet. By 1929 it had dropped to 275 board feet and in 1936 to 176 board feet—the lowest in about 100 years. This decline has been

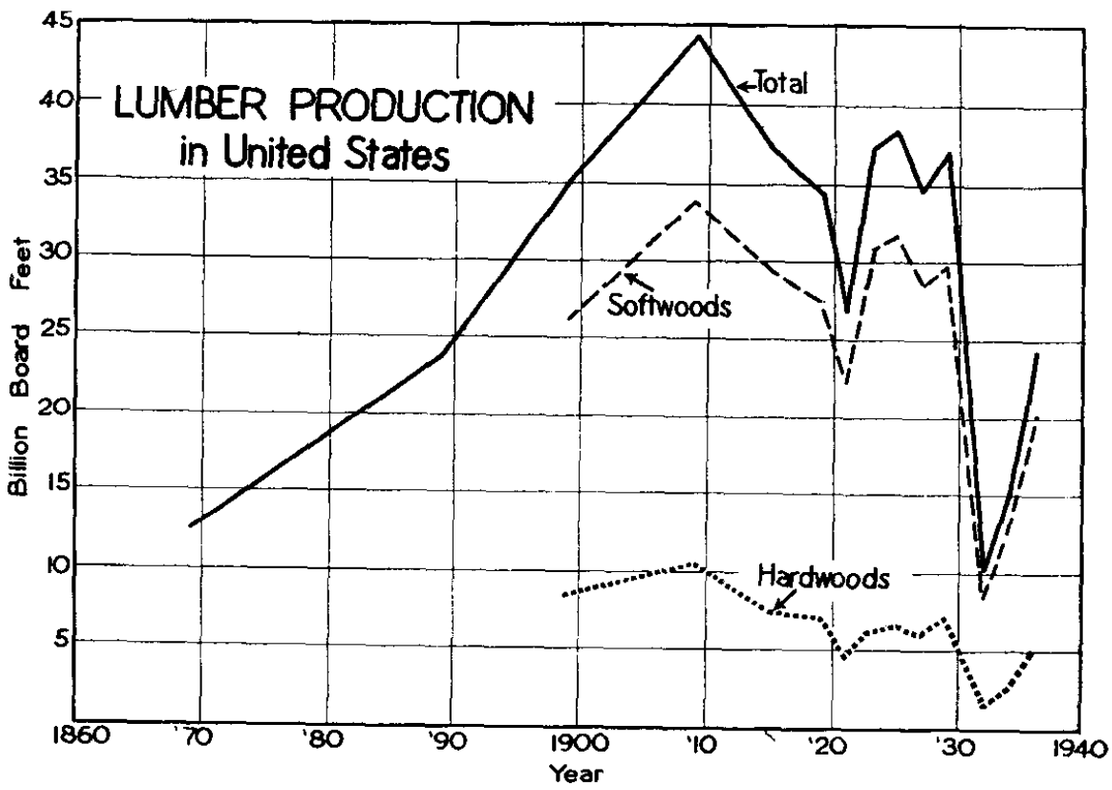

Fig. 13. Lumber Production in the United States.

due in part to the use of wood substitutes, the changing styles and customs in industrial and housing standards, the passing of the era of agricultural expansion, and the general depression in recent years. During this period of reduced lumber consumption, there has not been a corresponding reduction in lumber production. Because of this situation and other influencing factors, vigorous competition was inevitable.

VII. LUMBER INDUSTRY IS IN A PERILOUS CONDITION

No one who is familiar with the true situation will deny that the American Lumber Industry is in a perilous condition. Among the principal factors that have been burdening it are: (1) Overproduction, (2) Excessive investments in standing timber and operating equipment, (3) Excessive taxation, and (4) Competition from wood substitutes. A comparative study of the lumber industry with other industries shows that the annual value of its products is only about 25% of the aggregate value of its investment in timber and plants while in the automobile industry on the other extreme, the annual value of products is 50% greater than the total capital invested in automobile manufacture.

VIII. THE FUTURE OF THE LUMBER INDUSTRY

That lumbering has reduced to waste land millions of acres of productive forest land cannot be denied. It is just as true that the lumber industry has been one of the biggest constructive factors in the building up of our nation. The conviction is growing that in the future more and more attention will be given to the principle of sustained yield management of the forest, and that our forests will be looked upon as producers of cellulose, lignin, acetate of lime, and many other derived products, rather than primarily producers of logs, lumber and cordwood. Wood will become more and more a material for conversion into other substances from which finished goods can be made.

In 1936 the Directors of the National Lumber Manufacturers Association adopted a resolution which contained these words:

"We believe that forest industry should accept the responsibility and obligation to cut and protect their forest lands so as to provide for regrowth.

"We accept the continuous production, or sustained yield, of forest resources as the ultimate objective of industry. To hasten the attainment of this objective, we urge effective cooperation by State and Federal agencies."

In the July 1937 issue of the Journal of Forestry, William B. Greeley, former Chief of the U. S. Forest Services, under the title "Forest Industry Will Do Its Part," writes that:

"Forest Industry is in a transition from the older order to the new. It is gradually changing its methods and its thinking from the old viewpoint of timber as a *mine* to the newer viewpoint of timber as a *crop*. * * * The definite trend in forest industry today, as an obligation of good citizenship, is to leave its cut-over lands in good condition for regrowth. * * * Forest industry welcomes the opportunity to do its part."

QUESTIONS

1. When and where did lumbering begin in the United States? Did operations start in a big way or on a small scale? How was the first lumber made? Where were the principal early lumber markets?
2. Describe the early sawmills. Was plenty of good timber available for them? Compare these early mills with those of today.
3. Why did the lumber industry shift continuously? What effect did this shifting have on the forest and the people? Outline the general course of its migration throughout the country.
4. How does lumbering compare with other industries in size? When was the peak of lumber production reached in the United States? Was the peak reached at the same time in all forest regions?
5. What is a log boom? Describe several large ones.
6. Discuss stream, lake and ocean rafting.
7. Discuss some of the great changes that have taken place in logging methods.
8. What is a pit saw? a circular saw? a band saw?
9. Discuss the development of railroad logging.
10. Describe some of the modern logging methods.
11. Discuss the decline of the lumber industry. Describe briefly the rise and fall of a number of typical lumber towns.
12. What are some of the causes and consequences of vigorous competition in the lumber industry?
13. What are the principal factors that have been burdening the lumber industry?
14. What is the future of the American lumber industry?

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Author's Note: It is recommended that this chapter be illustrated with a large number of lantern slides, photographs, charts and other illustrative material. Excellent lantern slides, often full sets, can be obtained from State Education Departments, State Museums, the U. S. Forest Service, and a number of commercial agencies. Good motion pictures on logging and milling operations are available from the U. S. Forest Service and from some lumber companies and lumber associations.

CHAPTER VIII

EXPLOITATION AND DETERIORATION OF FOREST RESOURCES

I. FOREST EXPLOITATION

A. Meaning

The exploitation of the forests of the United States has been in progress ever since the first white settlers arrived. The progress, extent, and effects of this exploitation vary so widely from locality to locality and even between adjoining properties that no fixed definition of it can be offered, but among the common meanings of forest exploitation are: "Handling the forest without regard to the future," "Cutting the forest without making adequate provisions for forest renewal," "Getting value, uses, and services out of the forest without regard to others" or "Using the forest beyond one's right or exclusively for one's own profit." According to the U. S. Forest Service, "Devastated forest land is land which without artificial restocking will not produce a commercially valuable crop of timber within a tree generation" and, "A deteriorated forest or stand is one which, because of the treatment to which it has been subjected, has had its capacity to produce desirable wood and other forest products greatly reduced when measured in terms of value, either of quality or quantity."

B. Closely Related Terms

Forest Exploitation
Forest Destruction
Forest Devastation
Forest Depletion
Forest Deterioration
Forest Degeneration
Forest Decadence
Forest Desolation
Forest Bankruptcy
Deforestation
Vanishing Forests
Timber Famine

C. Stages of Forest Exploitation

1. *Selective* (*limited, local*) exploitation. Only a limited portion of the forest growth is removed, usually the choicest and most favorably situated trees. In early lumbering days in the Northeast only the choicest white pine trees standing upon the most favorable situations were cut.

2. *Wholesale* (*excessive, unregulated*) *exploitation.* With the rapid expansion of the lumber industry, exploitation was de-

veloped on a wholesale scale, usually with no restriction or regulation whatever. In general this stage continued until about 1900, and is still present in some localities.

3. *Restricted (reduced, checked) exploitation.* About 1900, and in some regions later, exploitation methods were modified somewhat, giving consideration to the unfavorable consequences of excessive and unregulated cutting.

4. *Controlled (planned) exploitation.* In recent years, and particularly with the adoption of the Lumber Code, some measure of control has been set up for the regulation of forest exploitation. This brings us closer to sustained yield management of forest resources. Some lumbering firms are now committed to a policy of sustained yield management. The West Coast Lumberman's Association in 1937 issued a revived edition of its "Forest Practice Handbook" in which sustained yield is recognized as a most important ultimate objective in bringing about proper forest management.

D. Extent of Forest Exploitation

The extent of forest exploitation varies from region to region and from locality to locality. In one region there may be little exploitation while in another it may be excessive. On one property it may be excessive and on an adjoining one reasonably well regulated.

On the basis of area, forest exploitation has gone far in the United States. The original forests covered 822,000,000 acres. Only about 20 per cent is now left, and most of it is in the South and the West with only a few scattered remnants in the East. Of the 495,000,000 acres of commercial forest land left in the country, 121,000,000 acres are stocked with trees of cordwood size and 185,000,000 acres are classed as logged and burned. Of the latter group 83,000,000 acres are described as poor to non-restocking and recent reports show that fully 60,000,000 acres will not produce commercially valuable timber within a tree generation without artificial planting.

The extent of forest exploitation and destruction can be measured in a general way by the per cent of forest land areas that remains in a number of representative states.

State	*Per Cent of Total Land Area Now in Forests*	*State*	*Per Cent of Total Land Area Now in Forests*
New Hampshire	77	Pennsylvania	45
Maine	76	Rhode Island	41
Florida	67	New York	40
Massachusetts	63	Ohio	15
Vermont	55	Illinois	9
Connecticut	51	Iowa	6.5*
New Jersey	46	Kansas	2.1*

* Vast areas of the prairie states were originally treeless.

That forest exploitation and devastation is still going on is claimed in the following estimate made in 1933 by the U. S. Forest Service:

Region	*Estimated Area of Forest Land Devastated Annually (Acres)*
New England	11,000
Middle Atlantic	6,000
Lake	90,000
Central	140,000
South	415,000
Pacific Coast	115,000
North Rocky Mountain	76,000
South Rocky Mountain	000
TOTAL	853,000

Against this annual increase in forest exploitation and devastation, there should be credited the amount of new forest that is growing up on areas upon which the forest was destroyed years ago. In some localities this acreage is considerable. John B. Woods makes the claim in the March 1938 issue of the Journal of Forestry that, "It is generally known, of course, that since 1930, yearly growth of our forests has equalled or exceeded in wood volume the total annual cutting drain."

E. Principal Causes of Forest Destruction and Deterioration

1. *Uncontrolled lumbering.* Even now, with a great curtailment of lumbering, about 10 million acres are cut-over annually.

2. *Forest Fires.* Annually they burn over 41,500,000 acres.

3. *Insects, fungi and other destructive agencies.*

4. *Unregulated grazing.* Over 70 per cent of all farm woods in the Corn Belt region is pastured.

5. *Over-expansion of agriculture.* Clearing land for agriculture has been the primary motive for destroying about 200,000,000 acres of our original forest. More than 50,000,000 acres of farm land is no longer needed for agriculture. It is available for forestry.

F. Effects of Excessive Forest Exploitation

1. Reduces forest resources in quantity, quality, and value.
2. Reduces forest growth, in quantity, quality and value.
3. Results in forest deterioration.
4. Raises prices of forest products.
5. Creates dangerous forest fire conditions.

6. Opens the way for destructive work of insects, fungi and other agents.
7. Creates an idle land menace, now aggregating in excess of 100,000,000 acres.
8. Destroys the food, shelter, and habitats of wildlife.
9. Reduces outdoor recreational opportunities.
10. Impairs scenic values.
11. Opens the way for erosion and has unfavorable influence on water supplies.
12. Causes decline and discontinuance of industries using forest products.
13. Decreases employment opportunities in the woods and industries.
14. Responsible for decadence and abandonment of whole towns and communities.
15. Reduces educational and health facilities and social opportunities.
16. Contributes to increase of local taxes, interest rates, and insurance premiums.
17. Increases farm abandonment in areas near exploited forests.
18. Contributes to curtailment and abandonment of transportation services.

II. FOREST DETERIORATION

Forest deterioration usually presents a far more difficult problem than forest exploitation, forest devastation, or even forest destruction. A culled forest, consisting chiefly of incomplete stands with inferior and defective species, neglected slash, uncared for growth, and without roads and other forest improvements presents one of the most difficult problems of forest management. As a rule, it is easier and cheaper to reforest bare land than to replace an inferior and defective forest growth with a satisfactory growth. It is not enough to "keep the forest green," for they may be green with impenetrable thickets of scrub oak, so common in the South, or dense thickets of inferior aspen, of which there are millions of acres in the Lake States. Such conditions are often far worse than if the forests have been completely destroyed. To displace this inferior growth is not only very difficult, but often prohibitive because of its excessive cost.

QUESTIONS

1. What is forest exploitation? How is it related to forest destruction, forest devastation and forest deterioration?
2. When did forest exploitation start in the United States? Has it progressed uniformly throughout the country? What four exploitation stages are recognized?
3. Discuss the extent of forest exploitation. In what sections of the country has it proceeded the farthest? Where has it been most excessive? At what rate is it progressing now?
4. What are the principal causes of forest destruction and deterioration?
5. List the principal effects of excessive forest exploitation.
6. How serious is the problem of forest deterioration?

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Chapter IX

EARLY GROWTH OF FORESTRY

I. FORESTRY AND THE PIONEER

Under the conditions that prevailed in pioneer days there was no general need for forestry. Almost everywhere forest resources were available far in excess of human needs. In many places the supply of them was so excessive that they were often a hindrance to necessary developments. But in spite of these abundant forest resources, there began to appear early in the life of our nation fragmentary rules, regulations, ordinances, and laws pertaining to the preservation and care of forests.

As early as 1626 the Plymouth Colony passed an ordinance prohibiting the cutting of timber on colony lands without official consent. In 1681 William Penn directed that in the Province of Pennsylvania (Penn's Woods) one acre of forest land be left uncut for every five acres cleared. A Massachusetts act of 1743 recognized the damage caused by forest fires to young tree growth and to the soil, and a North Carolina act of 1777 imposed penalties for the unlawful firing of the woods, declaring that forest fires are "extremely prejudicial to the soil."

In 1799 Congress set aside $200,000 for the purchase of a small forest reserve to supply ship timbers for the navy. In 1822 Congress authorized the President to call upon the Army and the Navy to protect the live oak and red cedar timber of the government in Florida. In 1827 the government started its first work in forestry, by attempting to grow live oaks in the southern states for ship timbers. Under this and previous acts about 244,000 acres of forest land were reserved in Alabama, Florida, Louisiana and Mississippi. An Act of 1831 provided for the punishment of persons cutting or destroying any live oak, red cedar, or other trees growing on any land of the United States. For about 60 years this Act remained as the only expression of interest in this part of the public domain.

These early efforts towards forestry bore little fruit beyond calling attention to the forest situation and presenting future forest problems in a very general way. It can be said, however, that these early efforts prepared the ground for a later sustained development of forestry.

II. THE PUBLIC DOMAIN

A. Acquisition of Public Domain

As early as 1780, under a resolution of the Congress of the Confederation, our federal government was granted the power to receive and take care of land. From 1781 to 1802 the various states ceded to the federal government 260,000,000 acres of land. The following year (1803) the Louisiana Purchase was made, and thereafter other vast areas were added to the federal lands by the Florida purchase, the Texas annexation, the Oregon occupation, the Mexico cession, the Alaska purchase, and other additions. By these various means in somewhat less than 75 years the United States government came in direct ownership of more than four-fifths of the mainland area of our country. This enormous acreage of federal lands became known as the Public Domain, which at one time consisted of 1,400,000,000 acres.

B. Disposal of Public Domain

The disposal of the Public Domain is of far greater significance in the development of forestry than its acquisition. For many years the sale of these public domain lands provided practically all of the national income. The giving away of enormous areas to settlers stimulated settlement and speculation. The Pre-emption Act of 1841 gave to actual settlers the right to purchase 160 acres. The Homestead Act of May 20, 1862, approved so highly by President Lincoln awarded 160 acres free to any able bodied citizen of good character who should agree to live on the property and develop it. This liberal land disposal policy was responsible for the rapid development of the rich prairie region of the Mid-west. Later on homestead entries in the more arid lands farther west were increased to 320 acres and still later the limit was raised to 640 acres. Other legislation such as the Desert Land Act of 1877, the Timber and Stone Act of 1878, and the Carey Act of 1894 made more and more liberal provisions for the disposal of federal lands. Land distribution during this period was progressing at an ever-increasing rate for a wide range of purposes and under an even wider range of conditions.

Enormous federal land grants were made to railroads to hasten the development of transportation facilities. Ten railroad corporations were given nearly 94,000,000 acres, of which 39,000,000 acres went to the Northern Pacific alone. In all, the railroads were given almost 130,000,000 acres of free land. Other large land grants were made to states, to educational institutions, for military bounties, for Indian reservations, for wagon roads and waterways and many other purposes. Today, the Public Domain comprises approximately 185,000,000 acres and practically all of it is cull land. All the other

land aggregating 1,210,000,000 acres, has been disposed of by the federal government in one way or another.

We know now that much of our nation's land wealth was quickly dissipated, and that most of the early development acts, such as the Free Timber Act, the Timber and Stone Act, the Homestead Act and the Desert Land Act, not only resulted in the squandering of land on a wholesale scale but also in frauds and thievery of the most extraordinary extent and in the wasteful exploitation of some of the finest forests in our country. The homesteading laws made no distinction between farm and forest land and as a result many million acres of the finest forest were taken up by dummies acting for lumber companies. This squandering of our national estate lands, forests, and other natural resources progressed to such an extreme under the pretense of building the nation that powerful corrective measures were required to set things aright. Beginning with the Forest Reserve Act of 1891 the pendulum has been swinging in a better direction. Now the federal government is again re-possessing much of the land that it once gave away, classifying it according to its best uses, and managing it in the best interest of all the people. Perhaps the extremely wasteful dissipation of our nation's land resources has helped hasten the day for a constructive conservation program.

III. PREPARATORY STEPS IN FORESTRY

A. Tree Planting Bounties

In general, little was accomplished in forestry in this country until after the Civil War. The settlers who migrated to the prairies of the Mid-west missed the trees that they were accustomed to in the East or in their former homelands in foreign countries. From 1861 to 1871 seven states (Iowa, Kansas, Dakota—then a territory—Nebraska, Minnesota, Missouri, and Wisconsin) passed laws to encourage tree planting. In most cases bounties or tax exemption were offered as an inducement. During this same period three western railroads began forest tree planting on a substantial scale. In 1870 for the first time, the United States Census included a survey of forest resources.

B. Arbor Day

Arbor Day, meaning *Tree Day*, was first celebrated in Nebraska in 1872 under the direction of Governor J. Sterling Morton. It is now an annual or semi-annual event in the schools of many states, as well as many foreign countries, and has been a big factor in developing a better appreciation and fuller understanding of our trees and forests. In some states as many as three arbor days are designated each year, two in the spring and the other in the autumn.

C. The Timber Culture Act

In 1873 the federal government added its support to the state's forest tree planting programs by passing the Timber Culture Act. By this act the federal government offered to donate a quarter of a section (160 acres) of public land to any person who would plant 40 acres of the same area to trees, not more than 12 feet apart each way, and keep the trees in a healthy and growing condition by cultivation for a period of 10 years. The act also provided that any homesteader who should, at the end of three year's residence, submit satisfactory proof of having had under cultivation for two years one acre of trees for each sixteen acres in his homestead claim should at once receive a patent. (*A land patent is a document conveying the title to land from the government to an individual, association or corporation*). The provisions of this act were abused to such an extreme that it became necessary to repeal it within ten years.

Records show that 10,000,000 trees were planted in Minnesota in 1876 and an equal number the following year. These tree planting efforts in the Mid-west were among the earliest practical undertakings in state forestry. That these early forest tree planting efforts gradually dwindled to almost nothing was unfortunate but it is significant that in 1934 an enlarged tree planting program under federal direction and at first known as the Plains Shelterbelt Project and now called the Prairie States Forestry Project, was launched on a gigantic scale, and is rapidly developing into one of the largest tree planting projects ever undertaken in this country.

IV. EARLY ADVOCATES OF FORESTRY

About one hundred years ago there began to appear a number of earnest advocates of forest conservation. As early as 1819, F. Andre Michaux, a French naturalist and later a substantial benefactor of American forestry, in his authoritative work on *The North American Sylva* wrote: "In America, neither the Federal Government nor the several states have reserved forests. An alarming destruction of trees for building has been the consequence, an evil which is increasing and which will continue to increase with the increase of population. The effect is already very sensibly felt in the large cities, where the complaint is every year becoming more serious, not only of excessive dearness of fuel, but of the scarcity of timber. Even now inferior wood is frequently substituted for the white oak, and the live oak, so highly esteemed in shipbuilding, will soon become extinct upon the islands of Georgia." This early warning voice was raised not by an American citizen but by a French naturalist and traveller. That Michaux not only saw the forest situation clearly, but took definite steps to correct it is evidenced by the fact that in 1855 he left a legacy of $14,000 to the American Philo-

sophical Society in Philadelphia to provide instruction about forestry and forest trees. Upon the death of his wife, this fund became available in 1870, and in 1877, Dr. Joseph T. Rothrock, who later became the father of forestry in Pennsylvania, was appointed Michaux Lecturer on Forestry at the University of Pennsylvania.

In 1832, J. D. Brown, in his *Sylva Americana* wrote: "Though vast tracts of our soil are still veiled from the eye of day by primeval forests, the best building materials are nearly exhausted, and this devastation is now become so universal to supply furnaces, glasshouses, factories, steam engines, etc. with fuel, that unless some auspicious expedition offers itself and means are speedily resolved upon for a future store, one of the most glorious and considerable bulwarks of this nation will within a few centuries be nearly extinct. With all the projected improvements in our internal navigation, where shall we procure supplies of timber fifty years hence for the continuance of our navy? The most urgent motives call imperiously upon our government to provide a seasonable remedy for such an alarming evil."

In 1837, Massachusetts provided for a special survey of the forest resources of the state. After several years of field work and study, Prof. George B. Emerson reported on the *Trees and Shrubs Naturally Growing in the Forests of Massachusetts.* Prof. Emerson was among the earliest advocates of forestry in America.

In 1865, Rev. Frederick Starr published a treatise on *American Forests, Their Destruction and Preservation.* In it he said: "It is feared it will be long, perhaps a full century, before the results at which we ought to aim as a nation will be realized by our whole country, to wit, that we should raise an adequate supply of wood and timber for all our wants. The evils which are re-anticipated will probably increase upon us for thirty years to come, with tenfold the rapidity with which restoring or ameliorating measures shall be adopted."

In 1868 George P. Marsh published his famous work on *Man and Nature* in which he considers at great length the effect of forest destruction on climate rainfall and floods. This book was later revised and under the title of *The Earth as Modified by Human Action* had a great influence on the early development of forestry in the United States.

In 1872 James Arnold bequeathed $100,000 to Harvard College to establish a professorship of tree culture and maintain an arboretum at Bussey Institution. From this bequest developed the Arnold Arboretum at Jamaica Plains, now one of the famous arboretums of the world.

A year later (1873) Dr. Franklin B. Hough of Lowville, New York, presented a paper at the meeting of the American Association for the Advancement of Science held at Portland, Maine, on *The Duty of Governments in the Preservation of Forests.* An outgrowth of this paper was Dr. Hough's appointment in 1876 as the first forestry agent employed by the National Government and an allotment of $2,000 for forestry studies, and later the establishment of the Division of Forestry in the U. S. Department of Agriculture in 1881.

V. GENERAL SUMMARY OF EARLY FORESTRY EFFORTS

The period of American forestry prior to 1880 may appropriately be called "The Period of Preparation." Developments in forestry prior to this time were rather general in nature and pertained chiefly to laying the groundwork for later activities. The extent of these developments during the late 60's, the 70's and early 80's is summarized in the following series of significant statements:

1867 (January 11) Michigan created a forest inquiry committee of three members. This was the first forest inquiry committee appointed by any state. On February 12, 1867 this committee submitted a 29-page report to the legislature.

1867 (March 23) Wisconsin created a forest inquiry commission of three members to inquire into the forest situation of the State. This commission submitted a 104-page report to the legislature.

1869 The State Board of Agriculture of Maine appointed a committee to develop recommendations for a state policy for the preservation and production of forest trees.

1870 The U. S. Census for the first time included a survey of forest resources.

1870 The Michaux legacy of $14,000 became available to provide instruction concerning forestry and forest trees.

1871 Minnesota enacted a law granting bounties to encourage forest tree planting.

1872 The first Arbor Day was celebrated in Nebraska.

1872 James Arnold bequeathed $100,000 to Harvard University to establish a professorship of tree culture and maintain an arboretum.

1872 A law was enacted in New York creating a State Park Commission to inquire into and report upon the advisability of vesting in the State the title of certain timberlands in the Adirondacks. Within a year the State holdings totaled 40,000 acres.

1872 California enacted a forest protection law making it a misdemeanor to wilfully or negligently set fire to any forest, brush, or other inflammable vegetation of another.

1873 Dr. Franklin B. Hough presented a report at a meeting of the American Association for the Advancement of Science at Portland, Maine on "The Duty of Governments in the Preservation of Forests."

1873 The Timber Culture Act was passed.

1874 President Grant sent a special message to the Congress in support of forestry.

1875 A forestry meeting was held at Cincinnati, Ohio. The American Forestry Association is an outgrowth of this meeting.

1876 The first allotment ($2,000) was made for federal forestry in the Dept. of Agriculture.

1876 The first federal forestry agent (Dr. Franklin B. Hough) was appointed.

1876 The Minnesota Forestry Association was founded. The State legislature provided an initial grant of $1,000.

1876 Colorado included in her original constitution provisions pertaining to the control of forest fires, the prevention of forest destruction and the adjustment of forest taxation.

1877 Dr. Joseph T. Rothrock was appointed Michaux lecturer on forestry at the University of Pennsylvania.

1877 Connecticut appointed a special commission of forest inquiry.

1878 The Timber and Stone Act was passed.

1878 Rhode Island enacted a law providing tax exemption on land on which 2,000 or more trees per acre were planted.

1878 Wisconsin set aside a tract of 50,000 acres in Vilas County as a timber reserve.

1881 A Division of Forestry was set up in the United States Department of Agriculture. It became the Bureau of Forestry in 1901, and The Forest Service in 1905.

1885 Four states—California, Colorado, Ohio and New York—formed administrative setups in their governments to handle forestry work.

QUESTIONS

1. Was there a real need for forestry in the early periods of our country's development?
2. How early in our nation's history were forest ordinances and regulations passed? In what part of the country were they first enacted? Did they do much good?
3. What is meant by the Public Domain? How was the Public Domain disposed of? Did the wasteful disposal methods of federal lands help usher in the era of conservation?
4. When did the real accomplishments in forestry begin in the United States? What were the chief factors that gave forestry a start?
5. What states passed laws encouraging tree planting between 1861-1871? Were any special inducements offered?
6. What is Arbor Day? When and where was it first celebrated?
7. Give the main features of the Timber Culture Act of 1873. Why was it repealed so soon?
8. Who were some of the early advocates of forestry in the United States? What were the outstanding contributions of Michaux? of James Arnold?
9. Were the early advocates of forestry concerned only with rapidly dwindling timber supplies, or did they also give attention to the effect of forest destruction on climate, rainfall, streamflow, and general welfare?
10. What contribution did Dr. Franklin B. Hough of Lowville, New York, make to forestry?
11. Discuss some of the outstanding achievements in forestry during the late 60's, the 70's and early 80's.

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CHAPTER X

PROGRESS IN FEDERAL FORESTRY

I. EARLY DEVELOPMENTS IN FEDERAL FORESTRY

A. The Beginning of Federal Forestry

Federal forestry began about 60 years ago. At a meeting of the American Association for the Advancement of Science held at Portland, Maine in 1873, Dr. Franklin B. Hough of Lowville, New York, presented a report on *The Duty of Governments in the Preservation of Forests.* This report was received so favorably that a committee was appointed to transmit a memorial on this subject to the national congress at Washington and to several state legislatures. President Grant was so favorably impressed with the recommendations that he transmitted a special forestry message to Congress on February 19, 1874. That year a bill was introduced into Congress authorizing a study of this important subject but it made no progress. The following year a similar bill was again introduced but like its predecessor it did not pass. The following year a rider was attached to the free-seed clause of the general appropriation bill, and was passed on August 15, 1876. This was the first federal law making an appropriation for forestry. The portion of this Act pertaining to forestry reads: "For the purchase and distribution of new and valuable seeds and plants, sixty thousand dollars; provided, that *two thousand dollars* of the above amount shall be expended by the Commissioner of Agriculture as compensation to some man of approved attainments, who is well acquainted with methods of statistical inquiry and who has evinced an intimate acquaintance with questions relating to the national wants in regard to timber, to prosecute investigations and inquiries with the view of ascertaining the annual amount of consumption, importation, and exportation of timber and other forest products. the probable supply of timber for future wants, the means best adapted to their preservation and renewal, the influence of forests upon climate, the measures that have been successfully applied in foreign countries or that may be deemed applicable in this country, for the preservation and restoration or planting of forests, and to report upon the same to the Commissioner of Agriculture to be by him in a separate report transmitted to Congress."

Only two weeks after the passage of this Act Dr. Franklin B. Hough was appointed an *Agent* in the Department of Agriculture to conduct the authorized investigations, and thus became the first federal forestry employee.

B. A Division of Forestry

In 1881 a Division of Forestry was created in the Department of Agriculture. For a full decade the chief function of this forestry

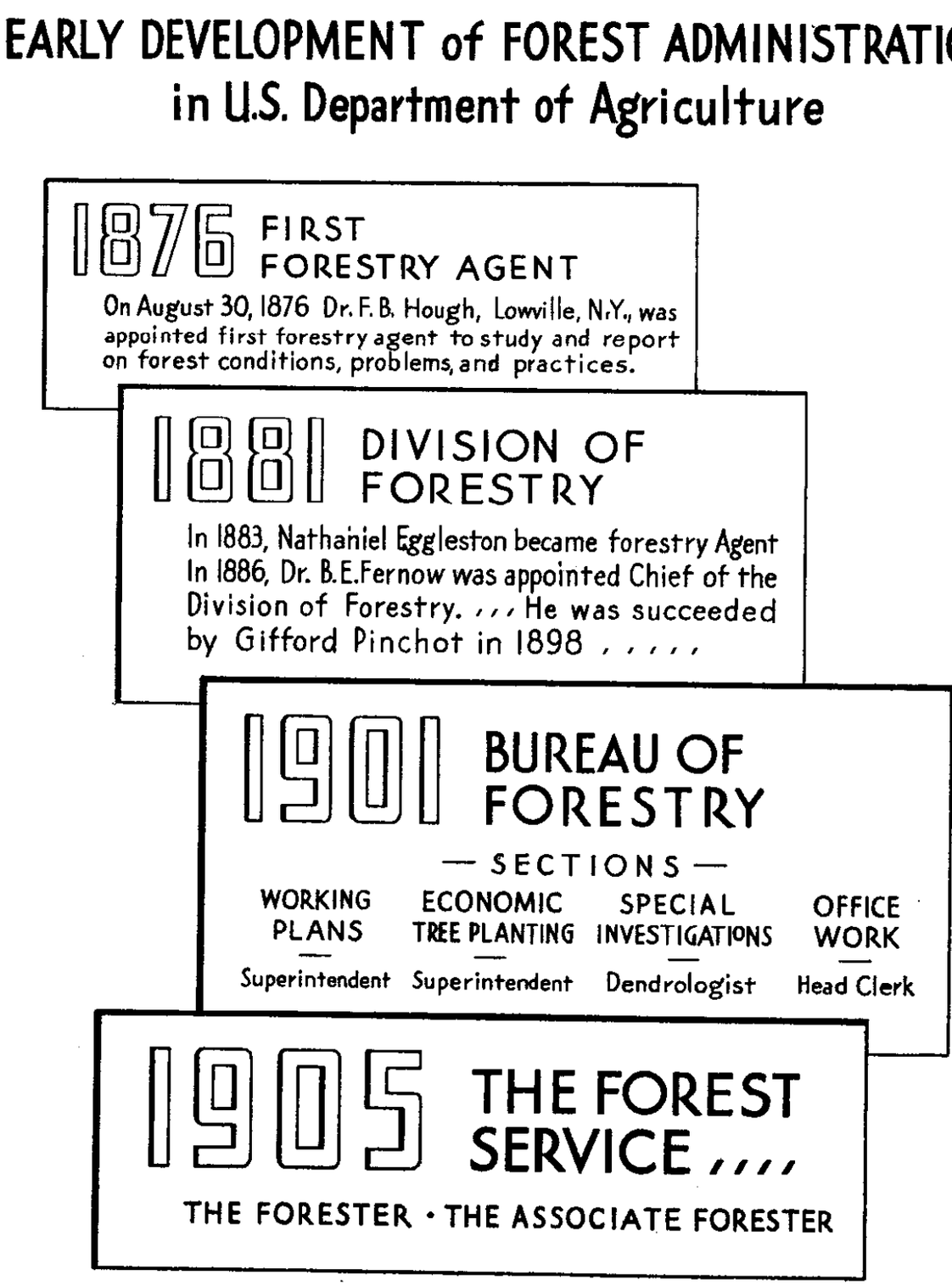


Fig. 14. Early Development of Forest Administration in U. S. Department of Agriculture.

division was the collection and distribution of information and the giving of advice about forestry. At that time the national government had no federal forest lands as such.

C. Creation of National Forest Reserves

The Act of March 3, 1891 authorizing the President to set aside forest reserves is among the most vital and fundamental of all forestry legislation enacted in this country. It provides: "That the President of the United States may, from time to time, set apart and reserve, in any State or Territory having public land bearing forest, in any part of the public lands wholly or in part covered with timber or undergrowth, whether of commercial value or not, as public reservations, and the President shall, by public proclamation, declare the establishment of such reservations and the limits thereof."

Twenty-seven days after the enactment of this law (March 30, 1891) President Harrison set aside the first forest reserve and called it the *Yellowstone Park Timberland Reserve.* Within a few months the President had withdrawn some 2,500,000 acres from the public lands and designated them as forest reserves. This new law was a step in the right direction, but it made no provision for their protection or administration.

D. Forest Reserves Grew Rapidly

By 1894, Presidents Harrison and Cleveland had set aside about 17,500,000 acres as forest reserves. On a single day, February 22, 1897 President Cleveland proclaimed 20,000,000 acres more. By the close of 1897, almost 40,000,000 acres were set aside. President McKinley added over 7,000,000 acres by 1901. In 1907 the name *forest reserves* was changed to *national forests* to better emphasize the fact that their resources are not reserved, but are being put to wise use. Between 1901 and 1909, President Roosevelt added 148,000,000 acres to the National Forests.

E. Tripartite Control

By the Act of June 4, 1897 Congress made the first provision for the administration of the federal forest reserves then under the control of the Department of Interior. At the same time the Division of Forestry in the Department of Agriculture was responsible for technical advice on forestry, and the U. S. Geological Survey with the surveying and mapping of the forest reserves.

F. A Bureau of Forestry

In 1901, the Division of Forestry in the Department of Agriculture was raised to the rank of a Bureau, which administrative rank it still holds, but is now generally known as The Forest Service.

II. THE FOREST SERVICE

The principal federal agency now engaged in forestry is the U. S. Forest Service.

A. Its Establishment

By the Act of February 1, 1905, the various federal forest activities were consolidated, and the control of the forest reserves was placed under the Secretary of Agriculture. By this same Act the Bureau of Forestry, designated only five months later on July 1, 1905 as The Forest Service, became for the first time *an administrative unit.* Until then its functions were limited largely to the collection and dissemination of information and the giving of advice. As late as 1902, all the forestry activities of the federal government were grouped under the following four general headings:

1. Forest management
2. Forest investigation
3. Forest tree planting
4. Forest records

B. Rapid Expansion of Activities

The great expansion of federal forestry during the next several decades can be appreciated from a statement of Col. William B. Greeley in 1927, then The Forester of the U. S. Forest Service, in which he said, "The Forest Service seeks to promote the best use, in the public interest, of all forest land and forest products in the United States." To achieve this purpose the forestry work was then grouped under such general activities as protection, utilization, development, investigation, cooperation, information, and acquisition.

C. Increase in Personnel

During its rather short existence many changes have taken place in the personnel of the U. S. Forest Service. There has been a notable increase in number, a marked modification in classification and a big improvement in training. The first person employed in forestry by the federal Department of Agriculture began service in 1876. Twenty-two years later, on July 1, 1898, only eleven per-

sons were engaged in federal forestry work, two of whom had technical training in forestry. By 1905, the number had increased to 821, by 1914 to 2,946 and by 1927 to 5,322. By 1938 the number had increased to 8,374, of whom 4,094 were forest guards, 789 forest rangers, 147 forest supervisors, and 92 were classified as regional foresters, assistant regional foresters and forest assistants. At no time since the spring of 1933 have fewer than 125,000 people been employed in the national forests, and at times the number employed has reached 250,000.

The men in charge of federal forestry work (all trained foresters, excepting the first two) with their period of service and titles follows:

Name	*Period of Service*	*Title*
Franklin B. Hough	1876-1883	Agent
Nathaniel Egleston	1883-1886	Agent
Bernard E. Fernow	1886-1898	Chief of the Division of Forestry
Gifford Pinchot	1898-1901	Chief of the Division of Forestry
	1901-1905	Chief, Bureau of Forestry
	1905-1910	The Forester of the Forest Service
Henry S. Graves	1910-1920	The Forester of the Forest Service
William B. Greeley	1920-1928	The Forester of the Forest Service
Robert Y. Stuart	1928-1933	The Forester of the Forest Service
Ferdinand A. Silcox	1933—	The Forester of the Forest Service. Since early in 1935 the official designation "Chief of Forest Service" is used.

D. Administrative Organization

The U. S. Forest Service is a Bureau of the Department of Agriculture. For about 30 years prior to 1935 the administrative head of the Forest Service was known as "The Forester" and directly subordinate to him was "The Associate Forester," both assisted by a number of Assistant Foresters in charge of major functional lines of work. The administrative head of the Forest Service is now designated officially as "Chief of the Forest Service." He is directly responsible to the Secretary of Agriculture, and has his official headquarter's offices in Washington, D. C. Next in rank to the Chief is the Associate Chief and subordinate to him are a number of Assistant Chiefs and an Assistant to the Chief.

The main grouping of administrative divisions of the Forest Service are now handled under the following headings:

1. National Forest Administration
2. Research
3. Administrative Management and Information
4. State and Private Forestry
5. Land Acquisition and Planning
6. Emergency Conservation Work (ECW)

The administrative divisions of the major administrative groups are shown in Fig. 15. Connected directly with the office of the Chief of the Forest Service is the Division of Fiscal Control. It concerns itself with fund accounting, cost accounting, property accounting, fiscal statistics, payrolls, audits, claims, compensation and other fiscal matters.

E. The National Forest Reservation Commission

The National Forest Reservation Commission was created by the Week's Law in 1911. This law specifies that the commission shall consist of the Secretary of War, the Secretary of the Interior, the Secretary of Agriculture and two members of the Senate to be appointed by the President of the Senate, and two members of the House of Representatives to be selected by the Speaker. This national commission is authorized to pass upon all lands recommended for purchase under the Week's Law and to fix the purchase price thereof. No land may be purchased under the provision of this law until approved by the commission.

The National Forest Reservation Commission has remained active since its creation in 1911. In recent years it has been especially active because of the greatly enlarged land purchase program made possible by the allocation of special emergency funds. On a single day—November 23, 1934, the National Forest Reservation Commission approved for purchase 2,053,169 acres of forest land. This is by far the largest acreage ever approved by the commission at one time. As of June 30, 1937, the total acreage approved for purchase by the commission since its creation was 14,239,621 acres, for which the consideration was $53,479,984.91, an average price of about $3.75 per acre. More than half of this area was purchased during the four years 1933-37. The Commission's report for 1937 recommends an uninterrupted continuation of the purchase program because there are about 148,000,000 acres of forest land now in private ownership that should be acquired and administered by public agencies; about 100,000,000 acres by the federal government and 48,000,000 acres by the states.

F. Present Regional Organization

The field organization of the Forest Service is set upon a geographic or regional basis. To prevent red tape and promote

efficiency in administration, the United States, including Alaska and Puerto Rico, is divided into the following ten regions, with a regional forester in charge at each headquarters:

Region (Number and Name)	*Headquarters*	*Territory*
1. Northern	Missoula, Montana	Montana, Northeastern Washington, Northern Idaho, Northwestern South Dakota.
2. Rocky Mountain	Denver, Colorado	Colorado, Wyoming, South Dakota, Nebraska, and Western Oklahoma.
3. Southwestern	Albuquerque, N.M.	New Mexico and Arizona.
4. Intermountain	Ogden, Utah	Utah, Southern Idaho, Western Wyoming, Nevada and Northwestern Arizona.
5. California	San Francisco, Cal.	California and Southwestern Nevada.
6. North Pacific	Portland, Oregon	Washington and Oregon.
7. Eastern	Washington, D. C.	Maine, New Hampshire to Virginia and Kentucky (14 states).
8. Southern (Established 1934)	Atlanta, Georgia	North Carolina to Florida. Texas, Arkansas and Oklahoma.
9. Lake States	Milwaukee, Wisc.	Michigan, Wisconsin, Minnesota, North Dakota, Iowa, Missouri, Illinois, Indiana, and Ohio.
10. Alaska	Juneau, Alaska	Alaska.

C. National Forests and Ranger Districts

To make possible an efficient handling of the national forest area, now aggregating 172,000,000 acres, they are organized into administrative units. The unit of administration is the *national forest.* Directly in charge of each national forest is a forest officer known as *Forest Supervisor.* There are now 157 national forests. Of these there are 120 in the west, 34 in the east, two in Alaska and one in Puerto Rico. All the states of the far west contain national forests. In the east, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware and Maryland do not have national forests.

The average size of national forests is somewhat in excess of 1,000,000 acres. The largest national forest is the Tongass with headquarters at Juneau, Alaska. It comprises more than 16,500,000 acres. The largest national forest in the United States proper is the Nevada National Forest with headquarters at Ely, Nevada. Its area is 3,059,667 acres. There are six national forests with an area in excess of 2,000,000 acres. Among these are the Tonto in Arizona, the Flathead in Montana, and the Gila in New Mexico. National forests with a

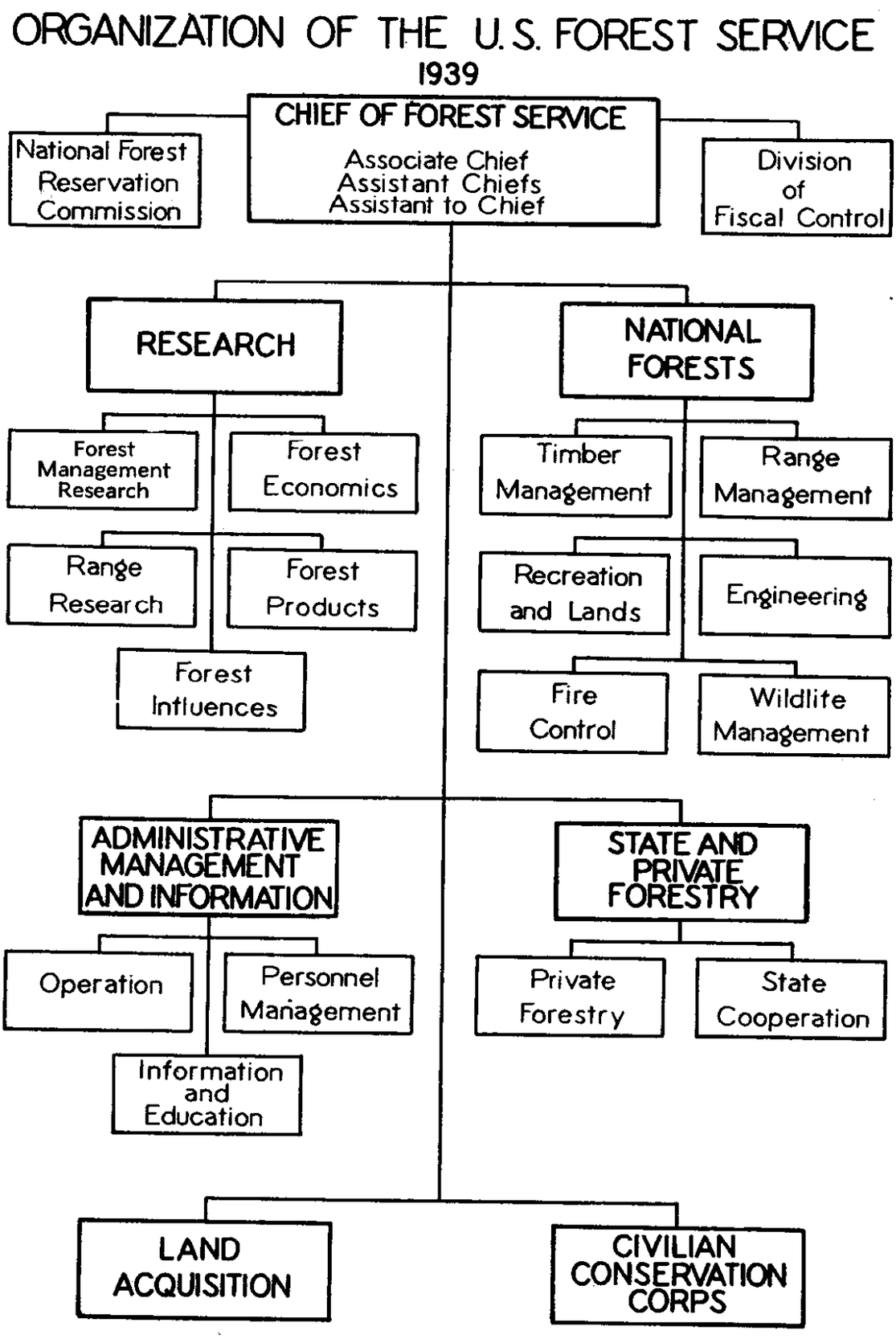


Fig. 15. Administrative Organization of U. S. Forest Service.

total net area of less than 400,000 acres are generally regarded as a small national forest. Most of the smaller national forests are in the east where purchase work is now rather active. Among the smaller national forests are the Bellevue-Savanna in Illinois (10,710

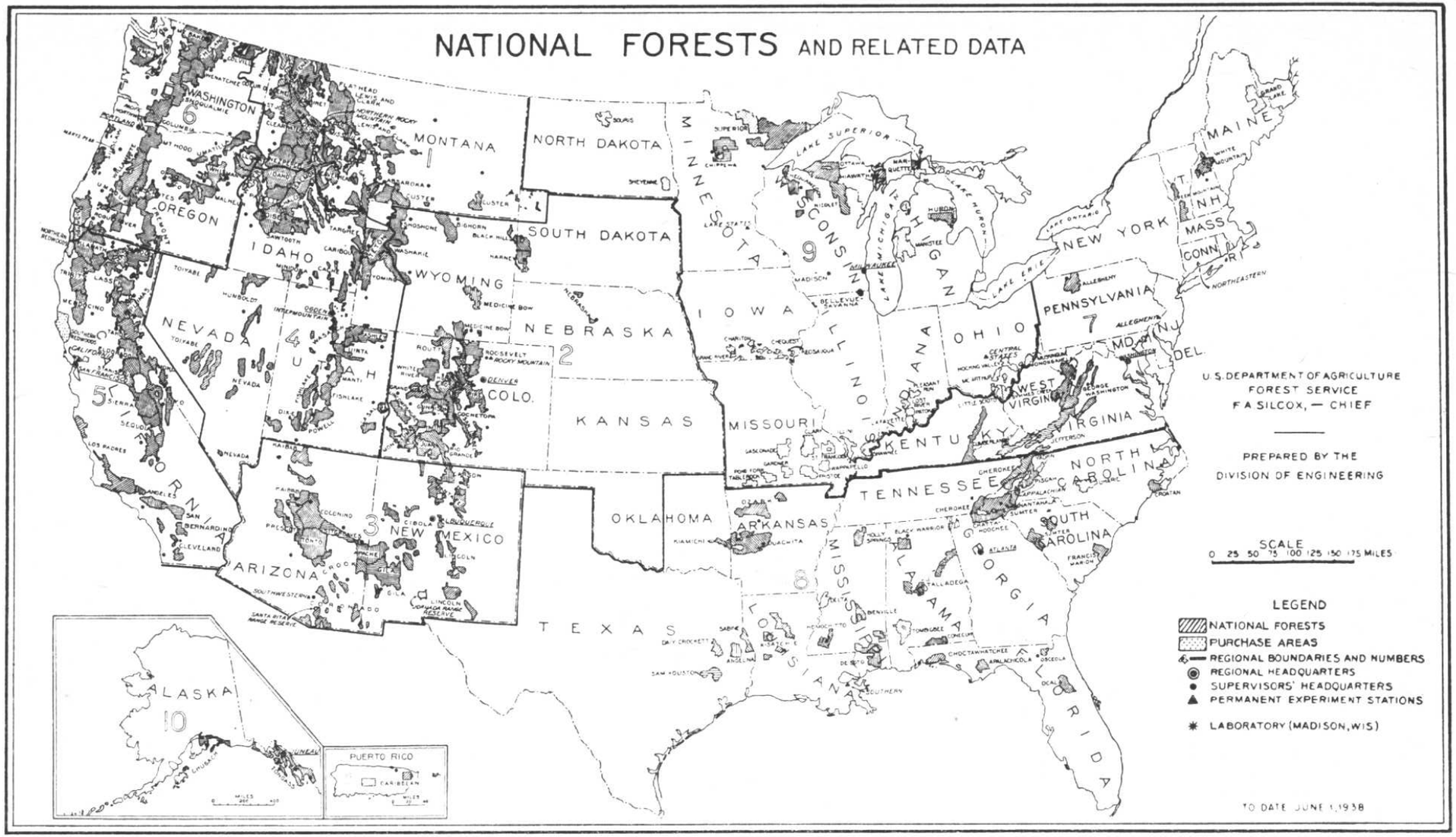


Fig. 16. National Forests of the United States (June 1, 1938).

acres), the Carribean in Puerto Rico (20,007 acres), the Croatan in North Carolina (112,775 acres), the Marquette in Michigan (165,101 acres), and the Cleveland in California (379,984 acres). The average size of the eastern national forests is approximately 360,000 acres; those in the western states average somewhat in excess of 1,325,000 acres. The five states with the largest number of national forests are California (17), Idaho (16), Colorado (14), Oregon (13) and Montana (12).

To carry on the work of the 157 national forests efficiently, they are divided into 737 *ranger districts*. Each ranger district is in charge of a *District Ranger*, who may be assisted by an *Assistant Ranger*. The average district ranger is the executive leader of 200 to 400 forest workers.

The number of ranger districts in national forests range from only one to nine. The Superior National Forest in Minnesota has nine ranger districts. Ten national forests have more than seven ranger districts, 35 have less than four, and 17 have only one ranger district. The average number for all national forests is five ranger districts.

The following table gives the number of national forests and ranger districts in the ten Administrative forest regions:

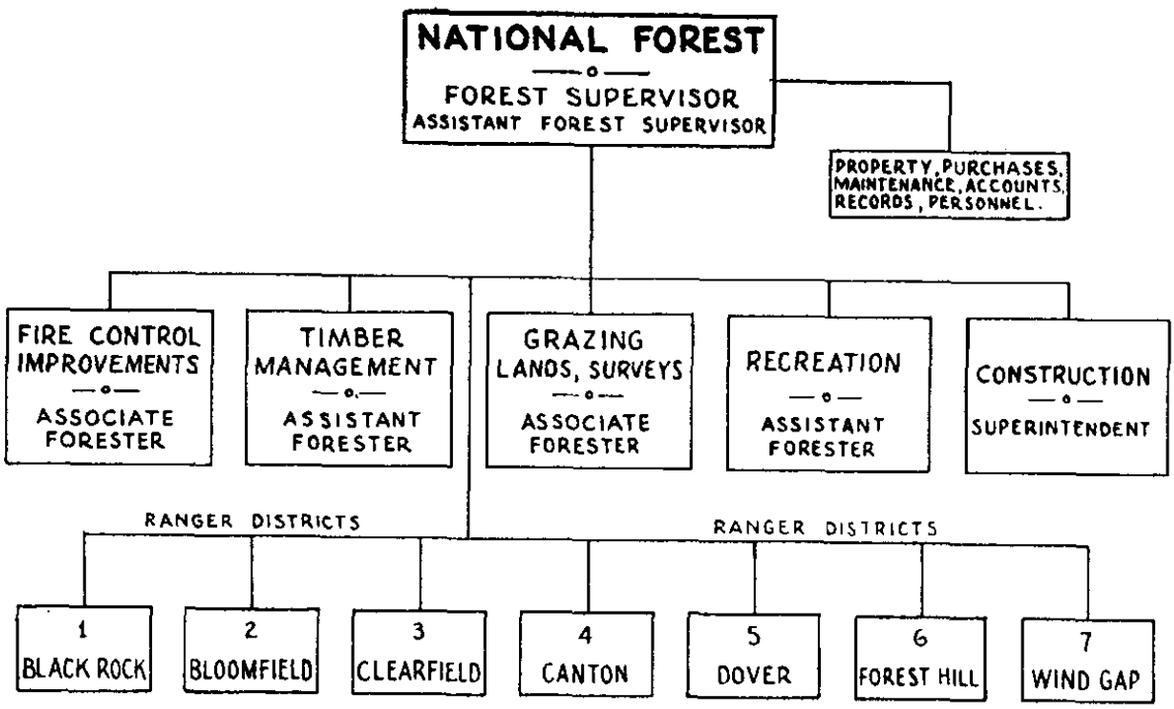
Forest Region	*Number of National Forests*	*Number of Ranger Districts*
1. Northern	17	106
2. Rocky Mountain	21	108
3. Southwestern	13	79
4. Intermountain	24	126
5. California	18	94
6. North Pacific	20	100
7. Eastern	7	25
8. Southern	26	50
9. North Central	9	44
10. Alaska	2	5
	157	737

H. Forest Improvements

To protect forest properties, facilitate their administration, and to make and keep them in a serviceable condition requires many different kinds of improvements. Among these essential improvements are roads, trails, telephone lines, lookout stations, towers, houses, camps, cabins, sheds, shelters, fences, etc. Many different kinds of operating equipment such as autos, trucks, tractors, road graders, and tools are also needed for the effective handling of forest properties. The Forest Service has pushed ahead with these improvements as rapidly as money could be secured for the purpose. Beginning with 1909, special appropriations have been made regularly for forest improvements. The present annual appropriations for this purpose are in excess of $25,000,000.

I. Enormous Increase in Recreational Uses

To campers, sportsmen, and seekers after health, rest, and recreation, the national forests offer splendid opportunities for outdoor life and enjoyment. The popularity of these great mountain play places is evidenced by the millions of people who visit them each year. Official figures show that during the fiscal year 1937 more than 30 million visitors used the 157 national forests for camping, picnicking, fishing and other forms of recreation. Thirty-three national forests had more than 100,000 visitors each during 1937. The Angeles National Forest in California recorded 1,481,000 visitors, the largest total of any one forest.



Each ranger district is in charge of a District Ranger. Subordinate to District Rangers are Assistant Rangers, Junior Foresters, Scalers, Forest Guards, Fire Lookouts, Packers, Foremen, and Laborers.

Fig. 17. How the Work of a National Forest is Organized.

J. Increasing Appropriations

The first fund available for federal forestry work was an allotment of $2,000 in 1877. The following table shows the rapid growth of general appropriations for federal forestry work by representative years:

Year	*Appropriation*	*Year*	*Appropriation*
1877	$ 2,000	1930	$ 26.903,337
1880	2,500	1932	37,961,110
1890	10,000	1934	75,984,670*
1900	48,500	1935	109,523,051*
1905	439,873	1936	117,876,498*
1909	3,896,200	1937	108,068,302*
1918	6,672,360		

* Includes emergency funds.

K. Fluctuating Receipts

The trends in the receipts from the national forests are shown in the following table:

Year	*Amount*	*Year*	*Amount*
1905	$ 73,276.15	1933	$2,626,049.14
1910	2,041,181.22	1934	3,314,691.34
1920	4,793,482.28	1935	3,291,311.84
1930	6,751,553.22	1936	4,062,963.18
1931	4,993,320.08	1937	4,936,183.06
1932	2,294,247.33	1938	4,608,853.00

From 1932 to 1935 the national forest receipts were reduced considerably due to the reduction of timber cutting on the national forests and a sharp reduction in grazing fees. Since 1935 there has

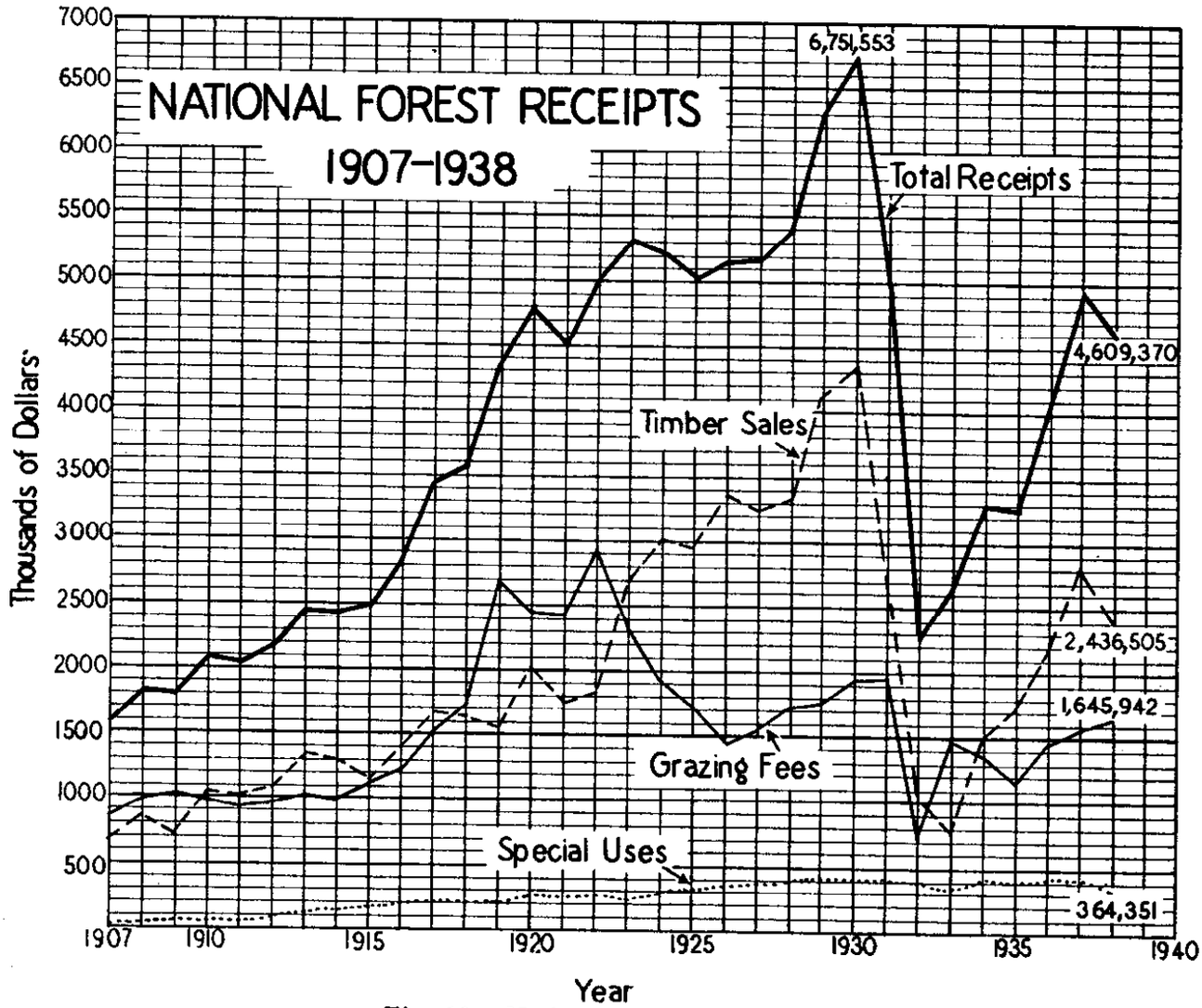


Fig. 18. National Forest Receipts.

been a steady increase of the gross receipts from the national forests. For the fiscal year ending June 30, 1938, they were made up as follows:

	Amount
From the use of timber	$2,435,000.00
From the use of forage	1,636,000.00
From special land uses, water power, etc.	537,853.00
TOTAL	$4,608,853.00

III. IMPORTANT FEDERAL FORESTRY LEGISLATION

A. The Weeks Law

Congress on March 1, 1911, passed what is now generally known as the *Weeks Law*, "to enable any state to cooperate with any other state or states, or with the United States, for the protection of the watersheds of navigable streams, and to appoint a commission for the acquisition of lands for the purpose of conserving the *navigability* of *navigable* rivers."

Four months after the passage of this act, sale proposals for more than a million and a quarter acres had been received. Under the Weeks Law and the amendatory Clarke-McNary Law more than 14 million acres had been acquired and fully paid for as of June 30, 1937 at an average price of $3.75 per acre. Most of the land purchased under this law is located in the eastern United States from Maine and New Hampshire to Minnesota and south to Florida and Texas. In recent years a number of purchases have been made in the west, including the northern redwood and the southern redwood areas in California, and the Mary's Peak area in Oregon.

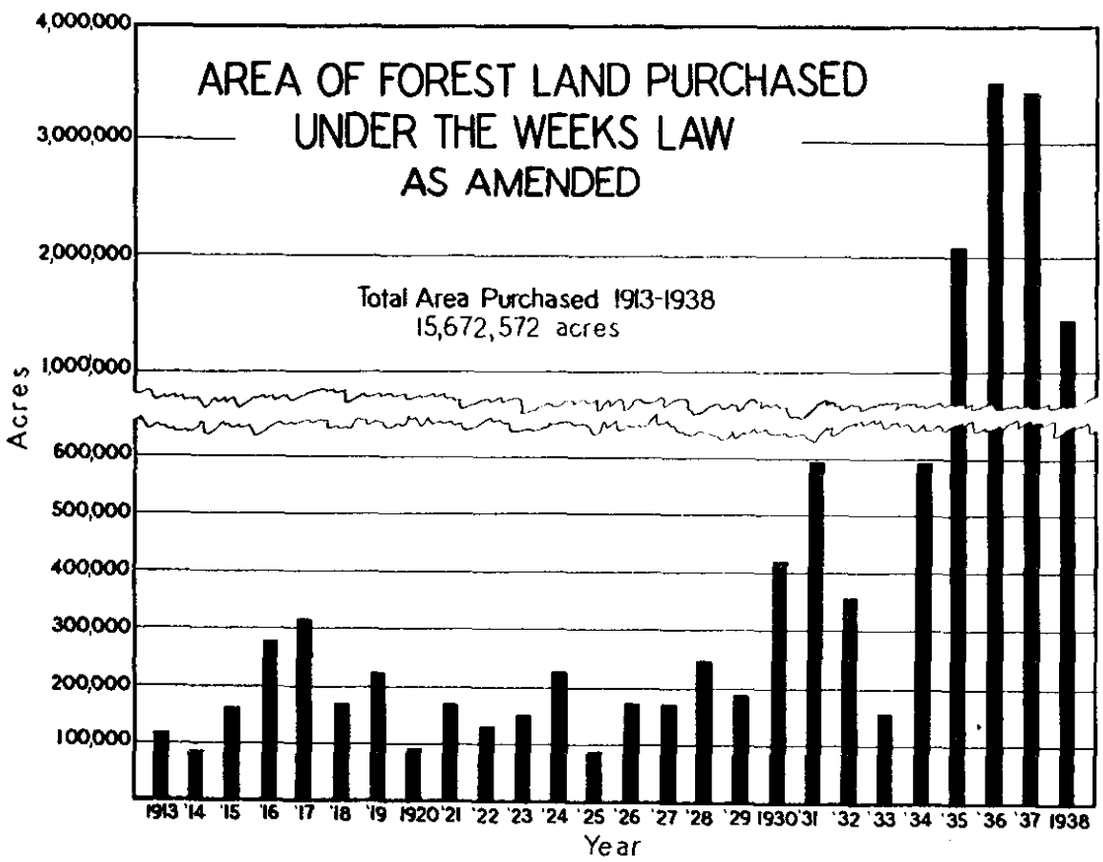


Fig. 19. Area of Forest Land Purchased under the Weeks Law (1913-1938).

B. The Clarke-McNary Law

This law of June 7, 1924, has extended materially the cooperation of the federal government with the states in the fields of forest fire prevention and suppression, the distribution of forest planting

stock and farm forestry extension activities. In 1911, the first year of cooperation under the Weeks Law, 11 states entered into agreements to protect a total of 7,000,000 acres of forest land, at a total cost of $350,000 of which the federal government contributed $37,000. For the fiscal year 1938 the total regular and special federal allotments to 40 states for forest fire cooperation was $1,603,-790.36, and for the distribution of forest planting stock $70,579.

C. The McSweeney-McNary Law

This law, passed in 1928, is usually called the McSweeney-McNary Forest Research Act. It defines the field of forest research, sets up a program of field research units including the Forest Products Laboratory at Madison, Wisconsin and the twelve Forest Experiment Stations, and outlines a ten-year financial program for forest research. This act has been directly responsible for appropriations in recent years that approximate national needs for forest research.

D. The Fulmer Law

The Fulmer Law, passed by Congress on August 29, 1935, authorizes the federal government to cooperate with the several states for the purpose of stimulating the acquisition, development, and proper administration and management of State forests and coordinating federal and state activities in carrying out a national program of forest-land management. This act authorizes appropriations by Congress from time to time not to exceed $5,000,000. No appropriation has been made to-date.

E. Cooperative Farm Forestry Law

On May 18, 1937 the cooperative farm forestry law was approved. It authorizes the federal government to cooperate in the development of farm forestry in the states and territories. It provides for such activities as growing trees and shrubs for afforestation and reforestation, advising farmers pertaining to the protection and management of their woodlands and the marketing of their forest products, and conducting investigations in the field of farm forestry. This law should stimulate forestry work in farm woodlots now owned by more than 2,500,000 farmers. It authorized an annual appropriation not to exceed $2,500,000.

F. Civilian Conservation Corps Law

On June 28, 1933 an Act was approved establishing the Civilian Conservation Corps for a period of three years and providing employment and vocational training for youthful citizens of the United

States who are unemployed and in need of employment. They may be employed on works of public interest or utility for the protection, restoration and development of natural resources, including lands, forests, and waters.

IV. OTHER FEDERAL FORESTRY AGENCIES

Other federal forestry agencies are considered in the next chapter.

QUESTIONS

1. When and under what conditions did federal forestry begin in the United States?
2. When was the Division of Forestry established? the Bureau of Forestry? the Forest Service?
3. Discuss the law by which the national forest reserves were established. Why was their name changed to national forests? How rapidly did they increase in acreage?
4. Discuss the increase in personnel of the U. S. Forest Service. Name the persons who have had charge of federal forestry work from 1876 to the present time, giving their titles and period of service.
5. Describe the present administrative set-up of the Washington office of the U. S. Forest Service and the regional organization in the field.
6. What is a national forest? a ranger district? a forest supervisor?
7. To what extent have forest improvements been added to the national forests? What increase has taken place in the recreational uses of national forests?
8. To what extent have federal appropriations for forestry increased? Discuss the fluctuation of national forest receipts.
9. What are the major provisions of the Weeks Law? the Clarke-McNary Law? the McSweeney-McNary Law? the Fulmer Law? the Cooperative Farm Forestry Law?

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Author's Note: Excellent illustrative material on federal forestry is made available by the U. S. Forest Service, Washington, D. C. and at its regional and local offices. Among the material available for general distribution is a set of 55 lantern slides on *The Work of The Forest Service* and a set of 60 slides on *National Forest Playgrounds* and a series of excellent motion pictures on a wide range of federal forestry activities. Full information on this educational material can be obtained from the Section of Information, U. S. Forest Service, Washington, D.C.

CHAPTER XI

PROGRESS IN FEDERAL FORESTRY (CONTINUED)

Not all of the forestry work of the federal government is carried on by the U S. Forest Service. At least a half dozen other units of the federal government have responsibilities in forestry. Among these are the National Park Service, The Indian Service, The Soil Conservation Service, The Biological Survey, The Extension Service, and The Tennessee Valley Authority.

I. FORESTRY IN THE NATIONAL PARK SERVICE

Forestry in the National Park Service is becoming increasingly important. This is not difficult to understand when one realizes that many national parks contain vast areas of forest land. The total area of the national park system is 19,193,933 acres, of which 7,926,108 acres (41.3%) are covered with natural vegetative types and 6,700,991 acres (35%) are forested. The following table lists six representative national parks with their total and their forested areas:

Name of Park	*Location*	*Total Area (Acres)*	*Forested Area (Acres)*
Yellowstone	Wyoming	2,221,772	1,773,698
Mount McKinley	Alaska	1,939,493	169.280
Glacier	Montana	984,309	628,830
Yosemite	California	752,904	558,724
Sequoia	California	386,560	226,000
Grand Canyon	Arizona	645,119	227,280

A. A Branch of Forestry

In 1933 a Branch of Forestry was set up in the National Park Service. It is in charge of a Chief Forester with headquarters at Washington, D. C. As early as 1928 a Chief Forester and a Fire Control Expert were appointed as field officers. The principal activities of this branch are the protection of park areas against forest fires, forest insects and forest diseases, the mapping of forest types, the promotion of forest studies, and the general beautification and betterment of forest stands. Closely associated with the forestry work is landscape engineering. In recent years an important new line of work has developed in this forestry branch, namely, the preservation and repair of important individual trees in developed areas and those of intensive public use.

B. Different Objectives of National Parks and National Forests

The main objectives of national parks and national forests are decidedly different. The principal purposes of national forests are timber production, streamflow regulation, waterpower production, grazing and simple forms of recreation. In general the national forests are managed for a large number of purposes (multiple-purpose management). In the national parks timber cutting, grazing, and other commercial uses are entirely excluded. They are primarily areas of original unmodified conditions, each the finest possible example of its kind in our country, and in most cases in the world. The preservation of wonder and of beauty were the first motives of national park making, and both remain among the primary motives today. The areas designated as national parks represent the highest examples of nature's work of creation and those charged with their administration aim to preserve them as nearly unmarred by man as possible. Education, recreation, and inspiration of the spirit are listed among the primary objectives of National Park Administration.

In considering the Nation's recreational resources, the National Resources Board in its report of December, 1934 said: "The federal government's responsibility is chiefly to preserve superlative examples of scenery, historical and archeological sites of national importance, and primitive areas, which have been defined by the National Park Service as tracts of virgin timber in which human activities have never upset the normal processes of nature."

II. FORESTRY IN THE U. S. INDIAN SERVICE

A. Area of Indian Forest Lands

Out of the great domain which the United States once bestowed upon the Indian only a part remains in Indian ownership. In 1887 the Indians owned approximately 138,000,000 acres of land. Legalized sales of Indian surplus lands, fee patents and allotments have reduced this acreage in 1938 to 52,000,000 acres, of which nearly 17,000,000 acres are classified as forest lands with an estimated stand of over 35,000,000,000 board feet. Recent estimates show 26,500,000,000 board feet of commercial timber on 5,200,000 acres.

B. Status of Indian Lands

The status of Indian lands was becoming more and more unsatisfactory until the Indian Reorganization Act of 1934. The General Allotment Act of 1887 had accelerated the allotting of tribal lands to individual Indians. Allotments vary in size but most of those with timber contain 80 acres. There are approximately 700,000 acres of allotted commercial timber and 4,500,000 acres of

tribal commercial timber. Some reservations have been completely allotted, while others escaped the practice. Practically no sales of Indian lands have been made since the passage of the Indian Reorganization Act of 1934. The complexity of ownership—tribal, allotted, heirship allotted, and fee patented—made sound forest management practice on many reservations difficult of performance and prevented permanent community forest development. The gradual return of allotted and alienated forest lands to tribal ownership will facilitate stabilized sustained-yield management on all of the important timbered reservations.

C. Sale of Indian Timber

While there had been a few acts authorizing the sale of Indian timber on particular reservations, the first general authority was contained in the Act of June 25, 1910, but it was not until about 1915 that timber sales began to be made on a large scale. Contractors have done most of the logging. From 1910 to 1938 approximately ten billion feet of timber has been cut on Indian reservations. Under authority of the Act of March 28, 1908, a large tribal sawmill has been operated on the Menominee Indian Reservation in Wisconsin on a sustained-yield basis. Over 600 million feet of timber have been cut on the Menominee Reservation in accordance with the 1908 act, for which the Indians have received over $4,600,000 in profits and stumpage in addition to a large amount of wages. The fixed assets of the plant total over $1,000,000. A similar but smaller Indian sawmill enterprise is conducted on the Red Lake Reservation in Minnesota.

D. The Division of Forestry and Grazing

Under authority of the Act of March 3, 1909, a forestry organization was established in the Indian Service in February, 1910. This organization was called at first the "Indian Forest Service" but was later designated the "Forestry Branch of the Indian Service." In 1931 the name of the unit was changed to the "Division of Forestry" of the Indian Service. Range management on Indian lands was an important function given to the organization in 1930. In order to make the name more descriptive of the work the name was changed in 1935 to the "Division of Forestry and Grazing" of the Indian Service.

Prior to 1915 the forestry work consisted chiefly of fire protection and the development of improvements such as roads, trails, telephone lines and lookouts. Since 1915 special efforts have been put forth by the forestry personnel in making cruises and timber

sales, control of logging operations so as to insure satisfactory reproduction following cutting, stumpage valuation reports, sawmill management, beetle control, forest improvements, silvicultural studies; and since 1930, range management and studies in regard to proper range use.

The central headquarters of the Division of Forestry and Grazing of the Indian Service is at Washington. The division is in charge of a Director of Forestry who has four assistants. There are five regional offices which are staffed with technical forestry and grazing men. The individual Indian reservations are in charge of a superintendent who has general supervision of all functions and work on the reservation. The forestry work is usually in charge of a forest supervisor who is assisted by forest examiners, forest rangers, timber scalers, and other forest workers. Most of the higher officials are technical men. The technical staff is recruited from the civil service list of junior foresters and junior range examiners. The Division of Forestry and Grazing employs approximately 200 men.

III. FORESTRY IN THE FEDERAL SOIL CONSERVATION SERVICE

Among the new federal agencies that concern themselves with forestry is the Soil Conservation Service. On August 25, 1933 the Secretary of Interior was advised that an allotment had been made to his department for studies in soil erosion. A Soil Erosion Service was promptly set up as a Bureau in the Department of Interior. In March 1935 the Soil Erosion Service was transferred into the Department of Agriculture and soon thereafter its name was changed to Soil Conservation Service. From the beginning of this service, forestry has played an important role among its activities.

The field work of the Soil Conservation Service in the United States proper is handled through eleven Soil Conservation regions, each in charge of a Regional Conservator. On the staff of the Regional Conservator in charge of forestry matters is a Regional Forester.

A. Section of Woodland Management

The forestry work of the Soil Conservation Service heads up in a Section of Woodland Management. It is a unit in the Division of Conservation Operations. Other units are Erosion Control Practices, Agronomy and Range Management, Engineering, Wildlife Management, Soil Conservation Practices, and Civilian Conservation Corps.

B. Classes of Woodland Work

The work of the Woodland Management Section falls largely into three classifications:

1. Planting forest trees and shrubs.
2. Woods management, including protection against fire, stand improvement, and management plans.
3. Cooperative development and management of community or association forests in agricultural areas.

It is estimated that a national plan of erosion control should increase the acreage in farm woodlands by at least 17 million acres, thus bringing the total well over 200 million acres. It seems probable that eventually the area of farm woodlands will reach a total of 225 to 250 million acres. More than 300,000,000 trees and shrubs have already been planted under the erosion-control program on approximately 100,000 acres of farm land. Principles of woodland management have been demonstrated by representatives of the Soil Conservation Service on more than 25,000 acres of farm woodland. The forestry work also includes the growing of forest tree planting stock in nurseries and the collection of forest tree seed for use in the nurseries. Much of the work of the Woodland Section was accomplished with the cooperation of the Civilian Conservation Corps.

C. Enlarged Responsibilities

The responsibilities of the Soil Conservation Service in forestry matters were enlarged considerably by the reorganization of the federal Department of Agriculture announced October 6, 1938. Under the new plan there is consolidated in the Soil Conservation Service all erosion control, water facility, flood control, submarginal land purchase and development, and farm forestry activities of the Department of Agriculture. This means that the execution of all physical land-use programs which involve operations by the government on farm lands is now consolidated in the Soil Conservation Service.

IV. FORESTRY IN THE FEDERAL AND STATE EXTENSION SERVICES

A. Beginning of Federal Forest Extension

Federal forestry extension work is a part of the general extension activities of the Extension Service in the Department of Agriculture. In 1919 only four states—Maryland, New York, North Carolina and Pennsylvania—offered forestry extension services. At first these services were available only through part-time extension foresters.

The first forestry extension work was made possible by the Smith-Lever law of 1914. It was not, however, until the enactment of the Clarke-McNary law of 1924 that forestry extension work began to function in an effective way. The Cooperative Farm Forestry Act of 1937 should add greatly to the forest extension program.

B. Purpose of Forestry Extension

Forestry extension is primarily missionary work. It aims to spread a working knowledge of forestry, chiefly among forest land owners, for the purpose of bringing about better forest practices. Among the main objectives of forestry extension are:

1. To bring about a fuller appreciation of the value of forestry.
2. To make available to forest land owners practical knowledge about forestry and forest practices.
3. To demonstrate and interpret desirable forest practices.
4. To help develop markets for forest products.

Like all other forms of extension work, forestry extension is primarily a program of education and demonstration. It has no forest land under its jurisdiction for protection, development and administration.

C. A Cooperative Activity

Forestry extension at present operates chiefly on a cooperative basis. The principal cooperators are the federal government and the states. The latter usually function through the State Agricultural Colleges. Federal funds are, as a rule, matched by state funds. The bulk of these funds are used to employ extension foresters. Forty states now (1939) employ a total of fifty extension foresters. One extension forester is also located in Puerto Rico.

D. Principal Activities

Some of the principal activities in forestry extension work are forest tree planting, woodlot improvement work, forest protection, disposal of forest products and land use.

E. An Enlarged Extension Program is Needed

To date forestry extension has been confined almost entirely to farmers. This means that it is concentrated on not more than 25 per cent of our country's forest land. The latest available records show that forestry extension has resulted in some form of forest betterment on about 32,000 farms in the United States. This is less than one farm in a hundred. Plans of the U. S. Forest Service call for a widespread expansion of forestry extension effort. To be effective, it must be directed not only to owners of farm woodlands,

but also to the owners, managers and users of industrial forests and to the general public. The Cooperative Farm Forestry Act of 1937 should increase forest extension work greatly and the Division of State and Private Forestry of the U. S. Forest Service is also enlarging its activities.

V. FORESTRY BY THE TENNESSEE VALLEY AUTHORITY (TVA)

In a special message to Congress on April 10, 1933 President Franklin D. Roosevelt recommended the creation of the Tennessee Valley Authority, which is charged with the broad duty of planning for the proper use, conservation, and development of the Tennessee River drainage basin and adjoining territory for the general social and economic welfare of the nation. In outlining his proposed plans President Roosevelt said:

"Such use transcends mere power development; it enters the wide field of flood control, soil erosion, afforestation, elimination from agricultural use of marginal land, and distribution and diversification of industry."

On May 18, 1933, Congress approved an Act creating the Tennessee Valley Authority.

A. Forest Area

The Tennessee Valley covers a total area of 26,300,000 acres. Surveys show that 50 per cent of the Valley, or about 13,500,000, is now in forests. An additional 3,000,000 acres is in need of reforestation and probably about 1,500,000 acres of present forests will be cleared. So it is estimated that the ultimate forest area in the valley will be about 15,000,000 acres. About 6,500,000 acres are in farm woodlands and approximately 2,000,000 acres in public ownership. The remaining 5,000,000 acres are mainly in large private holdings, which as a class are in a rather poor condition.

B. A Division of Forestry

Shortly after the Authority was established a Division of Forestry was created and placed in charge of a Chief Forester. Additional foresters were employed and activities started covering forest fire control, timber stand improvement, reforestation, forest tree nursery production, forest surveys, and forest education.

The Division of Forestry does not have sole responsibility for forestry in the Tennessee Valley. Here as elsewhere the responsibility for forest administration and development is divided between federal, state, minor public and private agencies. In fact, the Tennessee Valley Authority owns a relative small acreage of forest

land. There are about 118,000 acres of land above the normal water level in the Norris Lake region. Most of these lands are primarily adapted to forestry uses.

C. New Setup For Forestry

During 1937 the work of the TVA was completely reorganized. Forestry was definitely affected by this reorganization. The Division of Forestry with its Chief Forester was discontinued. In the new setup forestry appears in two places:

1. As a Department of Forestry Relations.
2. As a Forestry Operations Advisor on the Administrative Staff of Reservoir Property Management.

The Department of Forestry Relations is one of three departments under a Chief Conservation Engineer, in charge of "Water Control on the Land." The Department is in charge of a Chief Forester and an Assistant Chief Forester. On their technical advisory staff there is a Senior Forester and a Senior Forest Tree Crop Specialist. There are three Divisions in the Department, each in charge of a Chief. They are:

1. Division of Forest Resources Planning.
2. Division of Watershed Protection.
3. Biological Readjustment.

Much of the forestry work of the TVA is carried on not as independent projects but in cooperation with the U. S. Forest Service, the Agricultural Extension Service, the Farm Security Administration, the Biological Survey, the Bureau of Fisheries and the State Forest services.

VI. FORESTRY IN OTHER FEDERAL UNITS

There are at least a dozen additional bureaus, offices, services and administrations scattered throughout the federal government in which some phases of forestry have a place. Among these are:

A. The General Land Office (Department of the Interior)

At one time this office was one of the most important in the federal government. It is the custodian of the public domain, which has decreased greatly in area and importance, but still embraces approximately 190,000,000 acres. On the whole, this office has been a land disposal agency but in recent years it has also assumed responsibilities in land management. Among its forestry duties is the protection of the public domain lands against forest fires and other destructive agents. This work cannot be carried out effectively,

due to inadequate appropriations, which have been averaging only about $50,000 per year. Under such unfavorable conditions it has been possible to employ only a small number of forest patrols and lookout men during the main fire seasons.

B. O & C Lands (Department of the Interior)

The Oregon and California (O & C) lands located in 18 counties in western Oregon comprise 2,213,988 acres of some of the finest timber left in the United States. According to the federal forest survey these lands carry a total timber volume in excess of 46 billion board feet. Douglas Fir comprises more than 84 per cent of the volume, but there are also present substantial quantities of such woods as Incense Cedar and Port Orford Cedar. The latter is found in only four counties in Oregon, and the present demand for it far exceeds its growth. Here is an excellent opportunity to introduce the principle of sustained yield in a practical way.

On August 28, 1937 the President approved an Act passed by Congress placing these lands under the jurisdiction of the Department of the Interior and directing that the master purpose of their management be "permanent forest production." The Act also specifies that the timber on these lands "shall be sold, cut and removed in conformity with the principle of sustained yield." Under the provisions of this Act, an organization is now being developed to administer these O & C lands. It is in charge of a Chief Forester with headquarters at Portland, Oregon.

C. The Biological Survey (Department of Agriculture)

The forestry responsibilities of this bureau have been increasing rapidly in recent years, due chiefly to the large areas of land that have been placed under its jurisdiction. Most of these new lands are wildlife reservations, game refuges, or bird sanctuaries. Even before this recent increase in activities as many as 25 foresters were employed, and for some time a forester served as head of this survey. Many of the foresters employed in the Biological Survey have had special training in wildlife management. Many of the wildlife areas are stocked with a forest growth ranging from a few scattered trees to dense forest stands. It is the forester's responsibility to develop these forest stands in such a way that they will be of the greatest service as producers of food, shelter and habitats for wildlife.

D. The Bureau of Entomology and Plant Quarantine (Department of Agriculture)

Included among the activities of this bureau are some activities formerly handled by the Bureau of Plant Industry. Attention is given to such activities as the control of blister rusts, the Dutch elm disease, timber rots, and destructive forest insects. As many as 38

foresters have been employed on blister rust control alone. The services of an increasing number of forest pathologists and forest entomologists are required for the development of a complete forestry program. In recent years one of the main projects of this bureau is the control of the Dutch Elm Disease.

E. The Resettlement Administration

The Resettlement Administration, which was officially discontinued as of September 1, 1937, is being gradually liquidated. Some of its former functions were transferred to the Farm Security Administration, and others to the Bureau of Agricultural Economics in the Department of Agriculture. Formerly a large number of foresters were employed by this federal agency. In October 1938, most of the duties and responsibilities in forestry formerly handled by the Resettlement Administration were transferred from the Farm Security Administration to the Soil Conservation Service.

F. The Internal Revenue Bureau (Treasury Department)

This bureau employs regularly from 10 to 15 foresters. Their title is Valuation Engineer. Their work consists chiefly of the valuation of timberland and the analyzing of incomes from timber resources for federal income tax purposes. Special training and experience are necessary to qualify for these positions, which are filled through special Civil Service examinations.

G. The Bureau of Foreign and Domestic Commerce (Department of Commerce)

From 5 to 8 foresters have been employed regularly by this bureau. They are engaged chiefly in promotion of foreign trade in forest products and trade research. Their work pertains primarily to lumber and its use and its merchandizing. The foresters employed in these lines of work are usually classified as business specialists.

H. The Census Bureau (Department of Commerce)

The services of a small number of foresters are required regularly in the compilation of census data pertaining to forestry and forest industries. Reliable data about lumber production, lumber consumption, land classification, forest land use and other important forestry activities are becoming more and more essential to the developing of sound forestry programs.

I. Other Units

Also a small number of foresters have been employed from time to time by the Federal Trade Commission. The National Resources Board, The National Resources Committee and the President's Science Advisory Board have also given special consideration to the general forest situation and to special forestry problems.

QUESTIONS

1. What federal agencies in addition to the U. S. Forest Service carry on forestry work?
2. What proportion of the total area of different national parks is forested?
3. Outline the work of the branch of forestry in the national park service.
4. What are the main objectives of national parks? Distinguish between national parks and national forests.
5. Describe the management of Indian forests.
6. Discuss the operation of timber sales on the Indian forests.
7. Outline the principal forestry activities of the U. S. Soil Conservation Service.
8. Discuss the development of federal forestry extension work.
9. How many states carry on extension work in forestry?
10. When was forestry work started by the Tennessee Valley Authority? How was it reorganized in 1937?
11. Discuss the recent developments in handling the O & C forest lands in western Oregon.
12. What special lines of forestry work are carried on by the Biological Survey? the Bureau of Entomology and Plant Quarantine? the Bureau of Plant Industry? the Farm Security Administration?

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Author's Note: Numerous articles, pamphlets and bulletins have been issued by federal bureaus, offices, divisions and offices treating of forestry matters. Motion pictures (silent and sound) on a wide range of forestry subjects are available for distribution for general educational uses.

CHAPTER XII

PROGRESS IN STATE FORESTRY

I. THE BEGINNING OF STATE FORESTRY

State forestry began to emerge in a small way several hundred years ago. At first it developed slowly and irregularly. It had to break its own ground and work out its own development. No charted courses were available to give it direction. At times it stood still or even moved backward for lack of leadership and support. As early as 1653 the newly appointed Governor of New Sweden, now largely the State of Delaware, was instructed to "make rules for hunting and the preservation of the forest and prevent all indiscriminate cutting of trees." In 1681 William Penn directed that one acre of forest land be left uncut for every five acres cleared in the Province of Pennsylvania, and in 1777 a North Carolina law prescribed penalties for the unlawful firing of woods and declared that forest fires are extremely prejudicial to the soil. In 1819 Massachusetts enacted a law authorizing agricultural societies to offer premiums for the growing of oak and other trees required for shipbuilding. In 1851 an ordinance was passed by the newly formed *State of Deseret* (the Mormon settlement later called Utah) setting forth the conditions under which timber could be cut in Great Salt Lake County, and imposing a penalty of $100 upon any person who wastes, burns or otherwise destroys timber therein.

These five examples are typical of the many ordinances and laws pertaining to forests that were enacted during the early history of our country. That they accomplished much for forestry cannot be claimed. That they helped open the way for the later development of forestry is certainly true.

II. SPECIAL COMMISSIONS OF FOREST INQUIRY

From the 60's to the 80's of the last century a few people of vision began to give serious consideration to the economic and social implications of forest exploitation and the enormous destruction of forest fires. It was becoming more and more evident that the old "cut-out and get-out" practice of handling forests was wrong, but before any definite action could be taken it was necessary to know

more about the real forest situation, and to accomplish this a considerable number of state legislatures appointed special fact-finding commissions of forest inquiry.

A. Michigan and Wisconsin Led the Way in 1867

Michigan was the first state to create a special committee of forest inquiry early in 1867. Shortly thereafter Wisconsin created a commission of forest inquiry, consisting of three members. It was directed by the state legislature to investigate and report on the effect of clearing land of forests, the duty of the state in this matter, the need of experiments in tree growth, tree belts, and the proper management of forest trees. A complete report was submitted by the commission the same year, but the legislature took no special action on its recommendations. In fact, no major forestry development took place for the next 30 years, but exactly 30 years later (1897) a second commission of forest inquiry was created. It was more successful than the first one, for only a few years after its creation a State Department of Forestry was established.

B. Other State Forest Inquiry Commissions

Shortly after Michigan and Wisconsin led the way in 1867 it became the fashion of other states to have forest inquiry commissions. Two years later (1869) the State Board of Agriculture of Maine appointed a committee to formulate recommendations for a state forest policy. Other forest inquiry commissions were set up by legislative action in New York (1872), Connecticut (1877), New Hampshire (1881), Vermont (1882), Ohio (1885), Pennsylvania (1887), and North Carolina (1891).

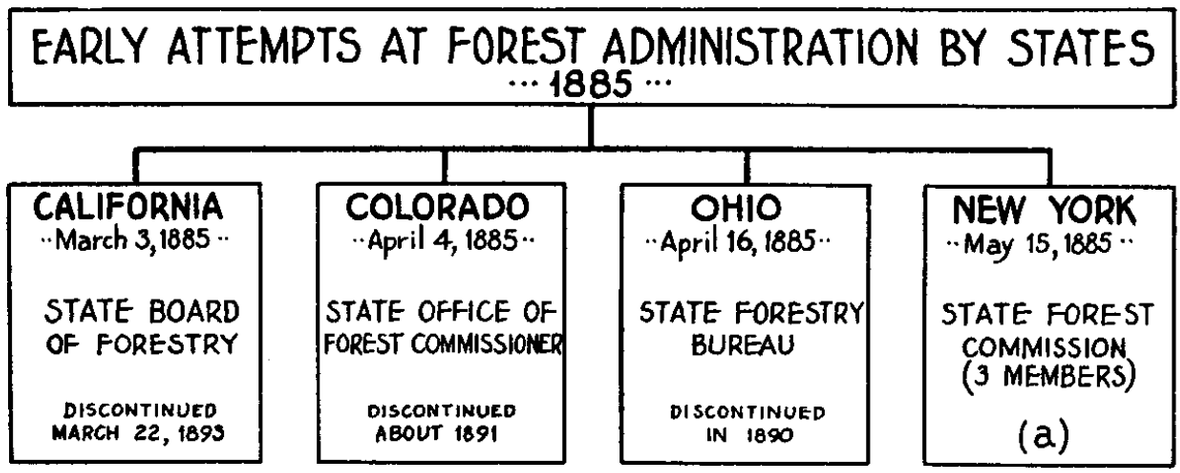
These early inquiry commissions were primarily fact-finding. They developed a better understanding of the forest resources of different states and pointed out the benefits of good forest practices. Most of these inquiry commissions were temporary in duration. Only a few of them existed long enough to develop into permanent administrative units of the state government. The greatest services of these early forest inquiry commissions was their preparatory work for later forestry programs.

C. Forestry Was Slow in Becoming Part of State Governments

In none of the older states was forestry a part of the original plan of state government. The state government of Virginia was in operation almost 150 years before forestry became a part of it. Pennsylvania had her state government functioning 119 years before 1895 when provisions were made for a small Division of Forestry in the Department of Agriculture. Almost 40 years passed by from the time Minnesota became a state until the State Auditor was made State Forest Commissioner in 1895. Oklahoma, raised to the rank of a state in 1907, made her first provision for state forestry in 1925. On the whole, forestry was slow in becoming a part of our state governments.

III. EARLY ATTEMPTS AT STATE FOREST ADMINISTRATION

Fifty-four years ago (March 3, 1885) California created a State Board of Forestry. This was the first state administrative setup, designed to be of a permanent character, for the handling of forestry in this country. By this act California is entitled to the distinction of being the first state to establish by legislative action



(a) STATE FOREST ADMINISTRATION IN NEW YORK STATE HAS HAD AN UNBROKEN DEVELOPMENT SINCE MAY 15, 1885, WHEN THE FIRST STATE FOREST COMMISSION WAS ESTABLISHED.

Fig. 20. Attempts at Forest Administration by States in 1885.

an administrative agency to handle forestry matters. Within three months three other states—Colorado, Ohio, and New York—also established administrative agencies for forestry. Of these four states, only in New York did the established forestry agency prove permanent in character. The original New York law of May 15, 1885 is generally accepted as the first comprehensive administrative forestry law in America. The original administrative setup for forestry in California, Colorado and Ohio lasted only 8, 6 and 5 years respectively.

Other states that took up state forestry prior to 1900 are:

1887	Kansas
1891	Maine
1893	New Hampshire
1895	Minnesota, Pennsylvania, Wisconsin

IV. THE GROWTH OF STATE FORESTRY

A. A Decade of Progress

The decade from 1900-1909 stands out conspicuously as the one during which the largest number of states established administrative setups to handle forestry matters. During this one decade sixteen

states started their forestry work in a formal way, and of these sixteen states, ten launched their forestry programs during the three years (1904-1906). By 1910 a total of twenty-five states had their forestry work moving forward under some form of administrative direction.

B. Increase and Improvement in Personnel

State forestry had not progressed far until it became clear that more and better personnel was required. Especially urgent became the need for trained foresters. In 1900 R. C. Bryant, the first graduate of the New York State College of Forestry at Cornell University and later Professor at the Yale Forest School, was employed as a forester by the State of New York. In 1901, George H. Wirt, a graduate of the Biltmore Forest School, began his long career in Pennsylvania forestry where he is in charge of all forest protection work of the State Department of Forests and Waters. The same year Walter Mulford, now head of the forestry school at the University of California, was appointed the first state forester of Connecticut, and thus became the first state forester of New England and of the United States.

From this small beginning at the turn of the century the personnel engaged in state forestry has increased rapidly. A recent survey shows that more than 300 technically trained men (chiefly forester) are now employed in state forestry work. The number of foresters employed regularly varies widely from state to state. It ranges all the way from one in Rhode Island, two in Delaware and six in Connecticut to forty in New York and sixty in Pennsylvania.

In addition to the trained personnel an even larger staff of forest rangers, forest inspectors, nurserymen, forest foremen, forest workers is regularly employed. Seasonal employment is also given to a large army of forest fire observers and forest fire fighters. And in addition to these regular and temporary forest employees are the emergency workers, such as the CCC boys.

C. Titles of State Forestry Officials

The prevailing title of the highest ranking state forest officer is State Forester. This title is now used in 30 states. Other official titles used are:

Commissioner of Forestry	Superintendent of Forestry
Director of Forestry	Supervisor of Forestry
Director of Forests and Lands	Chief Forester

Directly subordinate to the State Forester is usually an Assistant State Forester or Deputy State Forester. The foresters in charge of forest districts are usually called District Foresters (in one state Regional Foresters). Practically all District Foresters are technically trained men. Subordinate to the District Foresters are Forest Rangers, Forest Inspectors, Forest Surveyors, Forest Fire Observers, Forest Fire Wardens and many other temporary and emergency employees.

D. Increase in Appropriations

When state forestry started appropriations were small. Sometimes it started from funds raised by public subscription before state appropriations became available. The usual initial appropriation for forestry was $2,500 or $5,000. Sometimes this was for a year and again it was for a biennium (a two-year period). Gradually the regular appropriations have been increased until a few states have spent in excess of a million dollars a year for forestry. In addition to regular appropriations, large emergency allotments have been made in recent years for special state forestry projects.

E. Increase in State Forests

Early in the development of forestry, the desirability of state ownership of forest land became an important administrative objective. In 1872 a law was passed in New York naming a commission of seven members to study the advisability of reserving wild lands north of the Mohawk for watershed preservation purposes. By acquisition under tax sales state forest holdings increased from less than 40,000 acres in 1873 to more than 700,000 acres by 1883. This was the first substantial purchase of land for state forest preserve purposes in this country. Now the forest preserves of New York total almost 2,320,000 acres. In addition to the forest preserves in the Adirondacks and Catskills, the state has acquired almost 400,000 acres in reforestation areas. This land acquisition program is now going forward under an appropriation of $400,000 for the fiscal year 1938-39.

In 1897, Pennsylvania authorized the purchase of forest land at tax sales in the watershed of the three principal rivers of the state. On June 13, 1898, the first land was purchased. Now the state forests, formerly called forest reserves, comprise more than 1,600,000 acres purchased at an average price of $2.43 per acre. In 1899, Minnesota provided for state forest reserves and created a state board of forestry of nine members. Now Minnesota has 14 state forests with a total area of more than 1,000,000 acres.

The states having the largest acreage of state forests, not including state forest parks and special land grants, are:

State	*Area of State Forests (Acres)*
New York	2,750,000*
Pennsylvania	1,650,000
Michigan	1,050,000
Minnesota	1,030,000
Montana	203,000
Wisconsin	170,000
Massachusetts	120,000

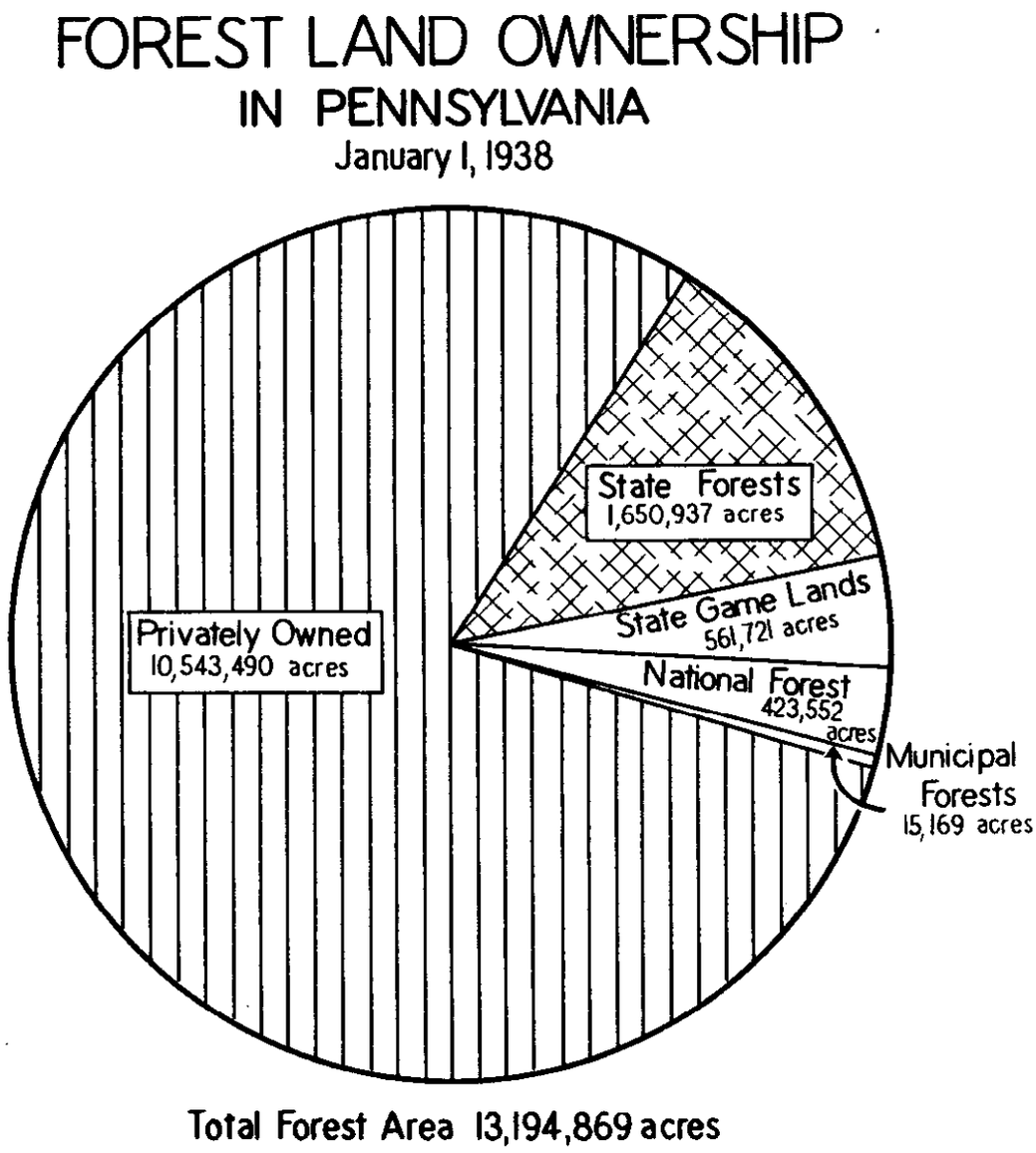


Fig. 21. Forest Land Ownership in Pennsylvania.

New York and Pennsylvania together have more than one-half of the area of state-owned forests in the United States. The New England and Middle Atlantic States have more than 60 per cent of all state forests. The Lake States rank second with somewhat in

* Includes forest preserves and reforestation areas.

excess of 2,000,000 acres. Only a few state forests are found in the South and Far West. Oregon has a state forest of 70,000 acres. It is the largest owned by any Pacific coast state.

F. Increased Forestry Services

At first state forestry comprised little more than forest protection, and often protection activities were limited to a part of a state or to a special phase of protection work. Now some states provide state-wide forest protection, and all of them are assuming more and more responsibilities in protection matters, including not only protection against fire but also against insects, diseases, and other destructive agents. Among other services in forestry that many states now provide are:

1. They collect and disseminate general and technical information about forestry.
2. They maintain forest schools.
3. They carry on research in forestry.
4. They operate forest tree nurseries.
5. They provide forest tree planting stock, usually at the cost of production.
6. They maintain demonstration forests.
7. They develop and manage state forests.
8. They provide recreational opportunities and facilities, including hunting and fishing, on state-owned lands.
9. They cooperate with counties, towns, associations, clubs and individuals in forestry matters.
10. They aim to coordinate forestry with other closely related conservation activities.

V. STATE FORESTRY MOVES SOUTHWARD

Prior to 1921, only four southern states — Virginia, North Carolina, Louisiana and Texas—had forestry units in their state governments. Since then forestry units have been set up in all of them. Alabama created a commission of forestry in 1923. Georgia established a department of forestry in 1925, changed it to a department of forestry and geological development in 1932, and in 1937 set up a division of forestry in a newly created department of natural resources. Oklahoma created a forest commission in 1925, and since 1937 a division of forestry has been functioning as a part of the state planning and resources board. Mississippi created a commission of forestry in 1926, and the following year (1927) Florida created a board of forestry and South Carolina a commission of forestry. The last of the southern states to include forestry in the state government setup was Arkansas. In 1931 she created a forestry commission but provided no appropriation to carry on its

work. The legislature of 1933 again adjourned without providing any funds for forestry work. Thereupon the Governor of the state raised $7,805.65 by public subscription for state forestry purposes. Since then appropriations have been made by the state legislature. On the whole, state forestry started slowly in the southern states, but in recent years it has made exceptionally rapid progress.

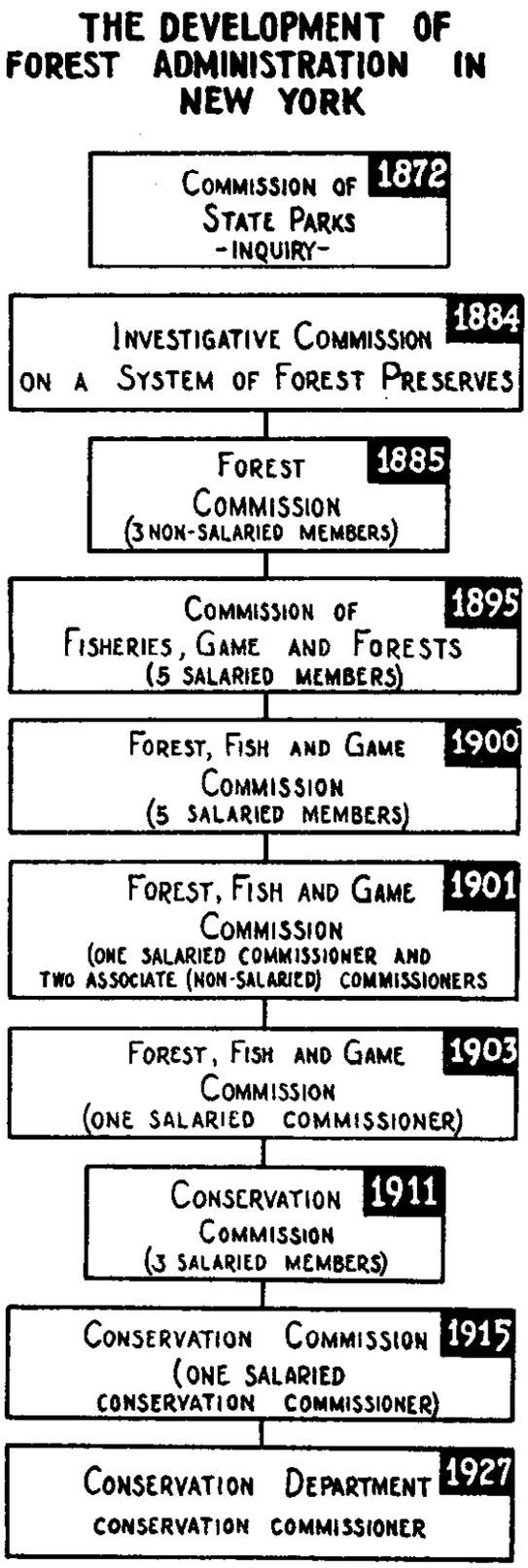


Fig. 22.

VI. FEDERAL AID FOR STATE FORESTRY

Much of the progress in forestry made by many states in recent years is due to federal aid. Three main lines of federal cooperation are now in effect, namely: (1) cooperative protection of state and private forest lands from fire, (2) cooperation in forest tree planting and (3) cooperation in farm forestry extension. Without this federal cooperation many of the states could not continue their forestry programs.

The first of these lines of cooperative forest fire protection began in 1911 with the enactment of the Weeks' Law. The first year only eleven states joined this cooperative program, to which the federal government contributed an average of less than $5,000 per state. Now forty states are cooperating in forest fire protection work and the federal government's contribution in 1938 exceeded $1,600,000. For the distribution of forest planting stock the federal government made a total contribution of more than $70,000 to forty-one different states in 1937. For cooperation with states in farm forestry during 1937 the federal appropriation is almost $57,000.

The amount of federal appropriations for state cooperation for the fiscal year 1938 are:

Forest fire prevention and suppression	$1,655,007
Distribution of forest planting stock	70,579
Farm forestry extension	56,838

This federal cooperation has been a great aid to state forestry. Without it, state forestry would be greatly handicapped, and in some states, the whole program might be wrecked.

VII. WIDELY DIVERGENT DEVELOPMENT OF STATE FORESTRY

There has been no single pattern for the fashioning of state forestry. In some cases the basic objective of the forestry program has differed from state to state, but more often the means to attain practically the same objective have differed greatly even in adjoining states. Throughout the entire development of state forestry, changes have taken place in many directions. Some of these changes have been so frequent and so drastic that later developments often have little in common with earlier efforts, and as a result state forestry presents an exceedingly diversified picture.

VIII. GENERAL CLASSIFICATION OF ADMINISTRATIVE SETUPS FOR STATE FORESTRY

A. States Without Any Administrative Setup For Forestry

1. Arizona
2. Nevada
3. New Mexico
4. South Dakota
5. Utah
6. Wyoming

B. State in Which Forestry is Subordinate to State Land Commissioners

1. Colorado
2. Idaho
3. Montana

C. States in Which Forestry is Handled by a Separate Board, Commission, Service or Department

1. Alabama
2. Arkansas
3. Delaware
4. Florida
5. Maine
6. Maryland
7. Mississippi
8. Nebraska
9. North Dakota
10. Ohio
11. Oregon
12. South Carolina
13. Texas

D. States in Which Forestry is Administered as a Unit of a Department, Board or Commission of Conservation

1. Illinois
2. Indiana
3. Iowa
4. Kentucky
5. Louisiana
6. Massachusetts
7. Michigan
8. Minnesota
9. Missouri
10. New Jersey
11. New York
12. North Carolina
13. Tennessee
14. Vermont
15. Virginia
16. Washington
17. West Virginia
18. Wisconsin

E. States With Special Administrative Setups For Forestry

(a) Department of Natural Resources
1. California
2. Georgia

(b) Department of Agriculture and Conservation
Rhode Island

(c) Forest, Fish and Game Commission
Kansas

(d) Park and Forest Commission
Connecticut

(e) Department of Forests and Waters
Pennsylvania

(f) Forestry and Recreation Commission
New Hampshire

(g) State Planning and Resources Board
Oklahoma

IX. THE FUTURE OF STATE FORESTRY

The future of state forestry appears to be promising. There is ample opportunity for expansion in many regions, but particularly in the East, the South, and the Central and Lake States. These regions offer the best field for state forestry since the forests of the West are already largely in federal ownership, and properly belong there. There can be no doubt of the desirability of a large increase in state ownership and management of forest land. The big determining factor will be the financial ability of the states to acquire the land. The Copeland Report recommends 77,000,000 acres as the ultimate total area of forest land that the states should own under present policies and plans. For a long time to come the states will continue to have among their main forestry functions the building up and maintenance of effective cooperation with private forest land owners.

QUESTIONS

1. When and how did state forestry begin in the United States?
2. What was the chief purpose of the early forest inquiry commissions and what did they accomplish?
3. When did forestry become a part of state governments?
4. Discuss the early attempts at state forest administration.
5. In what decade was the largest number of state forest setups created?
6. Discuss the increase and improvement of personnel in state forestry.
7. What are common titles of ranking state forest officers?
8. Discuss the increase in area of state forests.
9. Compare the services given in the early years of state forestry with those that are now offered.
10. When did state forestry move southward? Discuss its progress in the South in recent years.
11. To what extent and in what manner has federal aid affected state forestry?
12. Name six states that have no administrative setups for forestry.
13. Name three states in which the State Land Commissioners handle the state forestry work.
14. How many states handle their forestry work in separate departments, boards or commissions?
15. How many states handle their forestry work in a department, board, or commission of conservation?
16. Name several states that have unusual administrative setups to handle their forestry work.
17. Discuss the future of state forestry.

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CHAPTER XIII

COUNTY, MUNICIPAL AND PRIVATE FORESTRY

I. COUNTY FORESTRY

County forestry is not common in the United States. In 29 of the 48 states tax delinquent land reverts to the counties or towns. The area already delinquent has reached many millions of acres, but in only a few states have provisions been made for the consolidation and administration of these lands into county forests. The states in which county forestry has made some progress are Wisconsin, New York, New Jersey, Illinois, Michigan, and California.

A. County Forestry in Wisconsin

County forestry is more active in Wisconsin than in any other state. On March 15, 1938 twenty-five counties in Wisconsin contained a total of 1,746,647 acres of county forests. Conservation Director H. W. MacKenzie of Wisconsin in discussing county forests said: "The county forests of Wisconsin represent a unique adventure in public forestry. Together, the county and the state are engaged in a gigantic task to make again productive land that has been stripped of all its wealth. ***** County forests are in a very real sense local forests. The county owns the land. Local people have charge of their development and local labor is used in planting and protection work. With financial aid and technical assistance from the state, these dismantled lands may again play their part in the economic advancement of our northern Wisconsin region. This time, however, we want no temporary prosperity, no boom years followed by decay and depression. We want permanent forests producing permanent crops of forest products on which permanent industry and permanent employment may be sustained."

Already considerable progress has been made in the development of these county forests of Wisconsin. Special efforts are being put forth to control forest fires. At the close of 1937, a total of more than 40,000,000 trees had been planted on these county forests. Other achievements included stand improvement work on 23,000 acres, fire hazard reduction on almost 200,000 acres, protection against blister rust of 144,000 acres, and construction of almost 2,000 miles of truck trails.

B. County Forestry in New York

On March 26, 1929 a county reforestation law became effective in New York. In 1932, twenty-one counties made provisions for forestry work. They appropriated a total of $64,768.86 and received from the State an additional $45,501.94 for approved forestry projects. Each of six counties appropriated $5,000 or more, and one county appropriated almost $17,000. The county forestry programs give special attention to the purchase and reforestation of idle land in areas of less than 500 acres, the planting of forest trees, and the protection of the acquired areas against fungi, insects, and other destructive agents. Fencing of most areas has been necessary. For three years (1930-1932) the county reforestation program flourished. A total of 5 to 8 million trees were planted annually by the counties of the state. Since then, the county program has been greatly curtailed because of lack of contributions by the State, and necessary economy programs instituted by local county officials (board of supervisors).

C. County Forestry in California

Los Angeles, Ventura, and Santa Barbara counties have active county forestry organizations. Special reports of their activities are issued from time to time. Much attention is given to forest fire control, watershed improvement, park development, roadside beautification, and unemployment relief. The annual report of the Los Angeles county forestry department for the fiscal year ending June 30, 1937 submitted by the County Forester lists and interprets the forestry activities under two major divisions, namely, (1) forestry and (2) fire warden. The forestry division is subdivided into ornamental forestry and reforestation. From 1929 to 1937 the annual appropriations to the county forestry department ranged from $985,000 to $686,000. The appropriations for forestry in this single county of Los Angeles were considerably greater than those of many state forestry departments. Each year the County Forester and Fire Warden issue a comprehensive report that would be a credit to many state foresters.

D. County Forestry in Michigan

Early in the 20's forestry work was started in a number of counties in Michigan. Usually it is carried on under a Board of County Road Commissioners and comprises roadside developments, maintenance and development of county parks, and some reforestation. In Wayne county the roadside development work includes the planting of trees and shrubs, mulching, spraying, trimming and fertilizing of trees, seeding and sodding of road embankments, and other necessary operations involved in keeping the roadsides serviceable and presentable. This work is in charge of a Superintendent of Parks and Forestry.

II. COMMUNITY AND MUNICIPAL FORESTRY

A. In the United States

The idea of community and municipal forests is gaining ground rapidly in this country. There are more than 1,000 of these forests in twenty-seven different states. Some of them have been in existence for more than 150 years and have contributed substantially to the welfare of the communities to which they belong. For example, the town of Danville in New Hampshire has operated 77 acres of forest land almost from the time of its settlement in 1760. This land is under the management of a parsonage committee. In 1930 the committee reported $10,361.85 deposited in a bank with an interest item in excess of $400 which was used to help pay the community's minister. Newington, New Hampshire has a town forest of 112 acres valued at $5,800. During the past fifty years $6,000 worth of timber has been sold from it. Rutland, Vermont owns a forest of 3,500 acres. The town of Russel in Massachusetts with a population of 1,283 owns a town forest of 3,000 acres. Rochester and Glens Falls, New York, each own forests upwards of a 1,000 acres each. Baltimore, Maryland, has 15,425 acres of land, chiefly forest land under its water department, and Newark, New Jersey has 40,000 acres of forest land. These are only a few of the many cities and communities that own and administer forest land. The following table lists the leading states with their town, community and county forests:

State	*Number of Community and County Forests*	*Total Area (Acres)*
New York	390	188,884
California	158	65,241
Massachusetts	125	42,000
New Hampshire	83	17,260
Michigan	45	3,495
Vermont	42	10,000

B. Acquisition of Municipal and Community Forests

To make it legal for municipalities and communities to acquire and administer forest land a number of states passed necessary legislation. Among these states are:

1. New York
2. Massachusetts
3. New Jersey
4. New Hampshire
5. Vermont
6. Pennsylvania
7. Indiana
8. Ohio
9. Wisconsin
10. Michigan
11. Minnesota
12. Illinois
13. Nebraska
14. New Mexico

C. Principal Purposes of Municipal and Community Forests

The primary purpose of municipal and community forests may be quite different from national and state forests. Rarely is it timber production. More frequently it is watershed protection, the provid-

ing of recreational opportunities, and in recent years the providing of work reservoirs has come to the forefront. Perhaps watershed protection heads the list of purposes or objectives. New York City has planted more than two million trees on three watersheds about its three reservoirs at Ashoken, Gilboa, and Croton. More than two million trees each have also been planted on watershed properties of Rochester and Glens Falls, New York. The town and community forests also offer opportunities for community recreation, for the protection of wildlife, and the preservation of wild flowers. And especially important are the town and community forests as work reservoirs. They offer a means of putting idle men to work. The records of the community forests of Europe show that employment ranges from one man to 35 acres to one man to 100 acres. Community forests have the big advantage of being accessible. The work is accessible and the products are close to a market.

D. Community and Municipal Forests in Europe

The homeland of municipal forests is in Europe. Some of the city-owned forests in Europe are among the oldest managed forests in the World. Land records of The Sihlwald—the municipal forest belonging to the city of Zurich in Switzerland—go back for more than a thousand years. Detached notes on forestry have been traced back to the year 851. Two forest officers were appointed in 1460, and in 1491—one year before the discovery of America—the boundary lines were definitely marked. This forest while not large in area (2,848 acres) is rich in records, thrifty in growth, beautiful in appearance, orderly in arrangement and business-like in management.

Another interesting municipal forest of Europe belongs to the City of Heidelberg, Germany. It contains 7,000 acres of intensively managed forests. The first forest land came into the possession of Heidelberg in 1392—100 years before America was discovered. Among the outstanding features of the city forest of Heidelberg are the many stands of American forest trees.

Berlin has 58,277 acres of forests within the city limits or 24 per cent of its area. Frankfort-on-the-Main with an urban area of 48,066 acres has 10,473 acres of forests within the city and 1,260 acres outside the city. Gorlitz has none of its 7,546 urban acres in forests but it has the largest municipal forest in Germany, consisting of 72,430 acres outside the city.

Timber production is among the main objectives of most municipal forests in Europe. Considerable income is derived from them. In some cases the net income from the municipal forest is a big factor in reducing taxation. In a few cases no municipal taxes are levied because the net income from the forest is sufficient to meet necessary municipal operating expenses.

III. OTHER KINDS OF PUBLIC AND SEMI-PUBLIC FORESTRY

A. By Institutions

Institutions, such as colleges, universities, schools, and hospitals own and manage considerable areas of forest land. Among the well-known institution forests are The Harvard Forest in Massachusetts, The Yale Forest in Connecticut, The Keene Research and Demonstration Forest in New Hampshire belonging to Yale, The Arnot Forest near Cornell, The Duke Forest at Duke in North Carolina, The Bates Forest in Maine and the Pack Forests in New York and Washington. There are also a considerable number of public and private school forests scattered throughout our country. Most of them are relatively small in size. A few are handled under intensive management plans and for special purposes.

B. By Associations and Cooperative Organizations

Locally throughout our country are forests owned and managed by associations and cooperative organizations. The Peoples Forest (1,800 acres) near Winsted, Connecticut was established by the Connecticut Forest and Park Association. Other examples are The American Legion Forest in Connecticut, The Daughters of the American Revolution Forest in Texas, and Camp Woodland—a Boy Scout Forest of 800 acres near Syracuse, New York. Scattered throughout our country are many other forest areas used for scouting purposes. Upon some of them a practical plan of forest management has been introduced.

C. By Churches

Church forests are not common in the United States. The Moravian Church Forest at Nazareth, Pennsylvania, the forest tree plantation of St. Patrick's Parish at Colton, N. Y., the Stone Church Plantations in the town of Oswegatchie, N. Y., the Lutheran Church Woods at Cedarburn, Wisconsin and the forest lands of the Latter Day Saints of Utah are a few representative examples. Church forests are rather common locally throughout Europe. In Finland, church forests aggregate more than 550,000 acres.

IV. PRIVATE FORESTRY

Nearly 400 million acres, or about 80 percent of the commercial forest land in the United States is in private ownership. By far the largest contribution made by the private owner is in the field of forest fire control. Considerable progress has also been made in woodlot management, forest tree planting, and forest crop harvesting methods. A general attempt is also being made to introduce sustained yield management on some large privately owned forest properties. The principal groups of private owners of forest land now engaged in some form of forestry are:

A. Farmers

In this country there are about 127,000,000 acres of farm woodlands. On a large portion of it some form of forest management is now being practiced and in some woodlots are excellent examples of intensive forestry. Farm woodlands are managed primarily for special products needed on the farms and for a supplementary income to farming.

B. Corporations

Corporations are beginning to show some sustained interest in forestry. Among the principal kinds of corporations committed to definite forestry programs are:

1. Lumber companies
2. Pulp and paper companies
3. Naval store products companies
4. Water companies
5. Utility companies
6. Mining companies
7. Railroad companies

C. Clubs

Scattered throughout the country are many clubs, particularly hunting, fishing, outing, and other recreational organizations, that own a large acreage of forest land, for which definite plans of forest management suitable to their specific purposes are being put into effect.

D. Estates and Other Private Forestry Projects

Many private estates, located in all parts of the country, but chiefly in the East and South, include large areas of forest land upon which widely diversified forms of forestry are being practiced in keeping with the specific desires of their owners. President Roosevelt's Forest at Hyde Park, New York, is a good example of an interesting private estate forestry project. The Biltmore Forest on the Vanderbilt Estate at Biltmore, North Carolina comprises some of the oldest experimental forest tree plantations in the United States. The T. C. Luther Forest Preserve near Mechanicsville, New York is one of the largest private reforestation projects in the United States. From 1915 to 1929 more than 6,000,000 seedlings and transplants were planted on approximately 3,800 acres on this forest preserve. The Forest of Sheerlund (about 1,000 acres) on the Jacob Nolde Estate near Reading, Pennsylvania is among the most interesting and impressive private forestry projects in this country.

QUESTIONS

1. Where and to what extent has county forestry developed in the United States?
2. In what part of the United States has municipal forestry made most progress? Is there a need for more municipal forests in this country?

3. Discuss municipal forestry in Europe. What are the principal objectives of municipal forestry in Europe? Are they the same in this country?
4. Name several institutions in this country that own and manage forests.
5. Do associations and cooperatives own much forest land in this country?
6. In what country are church forests common?
7. Why should farmers be interested in forestry?
8. Is the lumberman's attitude towards forestry improving? What corporations are interested directly in forestry?
9. Outline the conditions and activities on The President's Forest at Hyde Park, New York.
10. Compare public and private ownership of forests.

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Chapter XIV

PROTECTION OF FORESTS AGAINST FIRES

I. GENERAL FOREST PROTECTION CONSIDERATIONS

Providing adequate and sustained protection against the many destructive agencies that constantly threaten the forest is a basic requirement in any sound forestry program. This is true whether the purpose of management is timber production, watershed protection, erosion control, wildlife management or recreational development. The good forester is ever alert for evidence of the presence or activity of any kind of destructive agent. The most important principle in the whole field of forest protection is that preventing the start of a destructive agent is far more effective than control efforts after the damage is under way. This principle holds true for all kinds of forest damage.

A. Principal Destructive Agents

1. Forest fires
2. Forest insects
3. Forest fungi
4. Domestic animals
5. Wild life
6. Inorganic agencies, such as wind, frost, snow, floods, erosion and shifting sands.

B. The Worst Enemy of the Forest—Forest Fires

Forest fires continue to be the most serious problem in American forestry. They are the greatest single obstacle to effective forest management. Official records show that in recent years more than 42,000,000 acres have been burned over annually in the United States. The number of forest fires that burn annually in this country is in excess of 150,000. In 1936, 159,459 forest fires were reported. No forest region is entirely free from forest fires, but in some regions the fire problem is far more serious than in others. All in all, forest fires continue to be a widespread national problem.

C. Kinds of Forest Fires

1. *Single Tree Fires.* They burn in dry snags or trees ignited by lightning or sparks from nearby engines, or are set on fire to smoke out game or to smoke bees. They are properly classed as tree fires if extinguished before they spread to adjoining trees or ignite the litter on the forest floor beneath them.

2. *Ground fires.* They burn in the duff, humus or peaty layers lying beneath the ground cover, litter or undecomposed portion of the forest floor. As a rule, they burn slowly and without flame. Sometimes they burn for several months. Cases are on record where they lasted throughout the winter under the snow. They are commonest in northern latitudes and high altitudes.

3. *Surface fires.* They burn on or near the ground in the leaf litter, underbrush and reproduction. They are the commonest kind of fire and occur in all kinds of forests in all parts of the country. Practically all forest fires start as surface fires.

4. *Crown fires.* They burn in the crowns of trees, and are restricted to coniferous trees, with inflammable foliage. Crown fires usually travel rapidly and advance in the direction of the wind.

D. Factors Influencing Severity and Spread of Forest Fires

1. Amount of inflammable material
2. Condition of inflammable material
3. Air movements
4. Humidity and precipitation
5. Topography

E. Forest Fire Seasons

Forest fire seasons vary widely from region to region and considerably from year to year. July and August are normally the peak forest fire months in many parts of the West. In the national forests of Oregon and Washington 75 per cent of lightning-caused fires occur, in an average year, in a 45-day period from July 11 to August 24. In the East, spring and fall fire seasons prevail, but occasionally there are also summer fire seasons. In New York State, from 50 to 70 per cent of forest fires occur during April and May, very few occurring during the summer and winter months, and as a rule, there is a short fire season in the fall just before the snow begins to fall. In the South, because of the absence of extended winters and the general lack of snowfall, excepting in small quantities and short duration, there are no distinct forest fire seasons. Records show that fires may occur any month in the year, but in a normal year they are most common in early spring (February, March and April) and in late summer.

II. CAUSES AND EFFECTS OF FOREST FIRES

A. Causes of Forest Fires

Forest fires are not natural to the forest. Excepting lightning-caused fires, which are rather common in parts of the West, most forest fires are caused by man, either by his carelessness or inten-

tionally. The number of forest fires that occurred throughout the United States during the five-year period 1932-1936 is grouped by causes in the following table:

Causes	NUMBER OF FOREST FIRES IN UNITED STATES Five Year Average 1932-1936			*Percent of Total*
	Protected Areas	*Unprotected Areas*	*Total Number of Forest Fires*	
Incendiary	17,023	26,267	43,290	25.8
Smokers	16,257	25,045	41,302	24.6
Debris burning	8,732	13,439	22,171	13.2
Miscellaneous	6,036	9,265	15,301	9.1
Lightning	5,045	7,738	12,783	7.6
Unknown	4,658	7,126	11,784	7.0
Campers	4,480	6,923	11,403	6.8
Railroads	2,817	4,378	7,195	4.3
Lumbering	1,053	1,630	2,683	1.6
TOTAL	66,101	101,811	167,912	100.0

B. Effects of Forest Fires

Forest fires do an enormous amount of damage. Some of the damage is obvious, but there are also indirect losses that are often not apparent and are difficult to analyze and appraise. Among the principal effects of forest fires are:

1. Forest fires injure and kill young, middle-aged and old trees.
2. They destroy seeds and seedlings (reproduction) that could grow into valuable tree stands.
3. They consume large quantities of felled timber and other forest products.
4. They destroy leaf and other litter on the forest floor.
5. They impoverish the soil, reduce its productive capacity, prepare the way for erosion and effect streamflow.
6. They destroy animal and plant life, including valuable forage.
7. They destroy and impair the beauty of the landscape.
8. They open the way for damage by insects, fungi and other destructive agents.
9. They frequently destroy buildings, crops and fences, and occasionally homes.
10. They are occasionally responsible for the loss of human lives.

CAUSES OF FIRES EXPRESSED IN PERCENTAGE OF THE TOTAL NUMBER OF FIRES

Average For The Years 1932-1936

Causes	*National Forests*	*Arizona*	*New Jersey*	*Maine*	*Michigan*	*Missouri*	*Oklahoma*	*Minnesota*
Lightning	36.6	*78.5*	.1	7.6	3.3	.3	.9	2.4
Railroads	2.0	.4	*22.3*	2.7	3.6	.5	.2	5.5
Campers	8.6	5.2	.7	*14.1*	6.4	3.8	1.5	6.9
Smokers	23.1	10.2	3.2	34.3	*50.4*	8.1	4.1	17.1
Debris Burning	9.2	1.0	8.1	11.4	13.6	*57.4*	2.1	25.4
Incendiary	13.7	1.2	1.3	11.1	11.2	17.7	*88.1*	5.0
Lumbering	1.6	.2	.0	*4.6*	.7	.5	.7	1.2
Miscellaneous	5.2	2.2	2.4	5.0	7.8	11.7	2.4	*33.8*
Unknown	.0	1.1	*61.9*	9.2	3.0	.0	.0	2.8
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

III. PROGRESS IN FIRE PREVENTION AND CONTROL

Complete elimination of forest fires is rarely attainable. Desirable as it may be, man-caused fires cannot be eliminated from the forest any more than from our own homes. Occupancy and use of the forest implies legitimate need for fire, and some of these fires are bound to escape through carelessness or negligence and in some cases intentionally. Therefore, in the effective handling of forest properties it is necessary to make provisions for the control of all fires that may start from a wide range of causes.

Organized forest fire control work began on the national forests about 1910. In a few of the eastern states it started earlier, but in most of them it was organized about the same time or later than on the national forests. Now most states have some form of organized forest fire control set-up. As late as 1913 less than one-half of the forest fires of Pennsylvania were reported to forestry officials, but now there is in effect a statewide system of forest fire prevention and control, and more than 98 per cent of all forest fires are promptly reported, and well organized and fully equipped crews are dispatched immediately to extinguish them.

That substantial progress has already been made in providing better protection to the forests of the United States is becoming more and more apparent both from official records and from the improved condition of the forests themselves. The following conclusions and discussion topics attest to this fact:

1. *Size of the average forest fire has been decreasing rapidly.* The following table shows how period by period forest fires have been getting smaller and smaller:

NEW YORK*

Period	*Size of Average Forest Fire (Acres)*
1903-06	478
1907-11	233
1912-16	53
1917-21	31
1922-26	25
1927-31	9
1932-36	8

NATIONAL FORESTS

Period	*Average Number of Acres Burned Per 1,000 Acres Protected*
1910-14	7.2
1931-34	2.1
1935-36	1.6

It is noteworthy, however, that more forest fires occur now than 10 to 15 years ago. This increase is largely explained by a more complete reporting of forest fires and by a greatly increased use of forest areas for a wide range of business and recreational uses.

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* For fire towns only which comprise all the heavily forested regions of the Adirondacks and Catskills.

2. *Total forest area burned over annually has been decreased considerably.*

3. *Greatly increased forest area is now given fire protection in this country.*

According to the U. S. Forest Service, 320,757,192 acres of forest land are now given protection in this country. This represents 62% of the total forest area requiring protection. The protection is, however, not uniformly distributed by regions or states nor is it of equal intensity and effectiveness everywhere. Of-

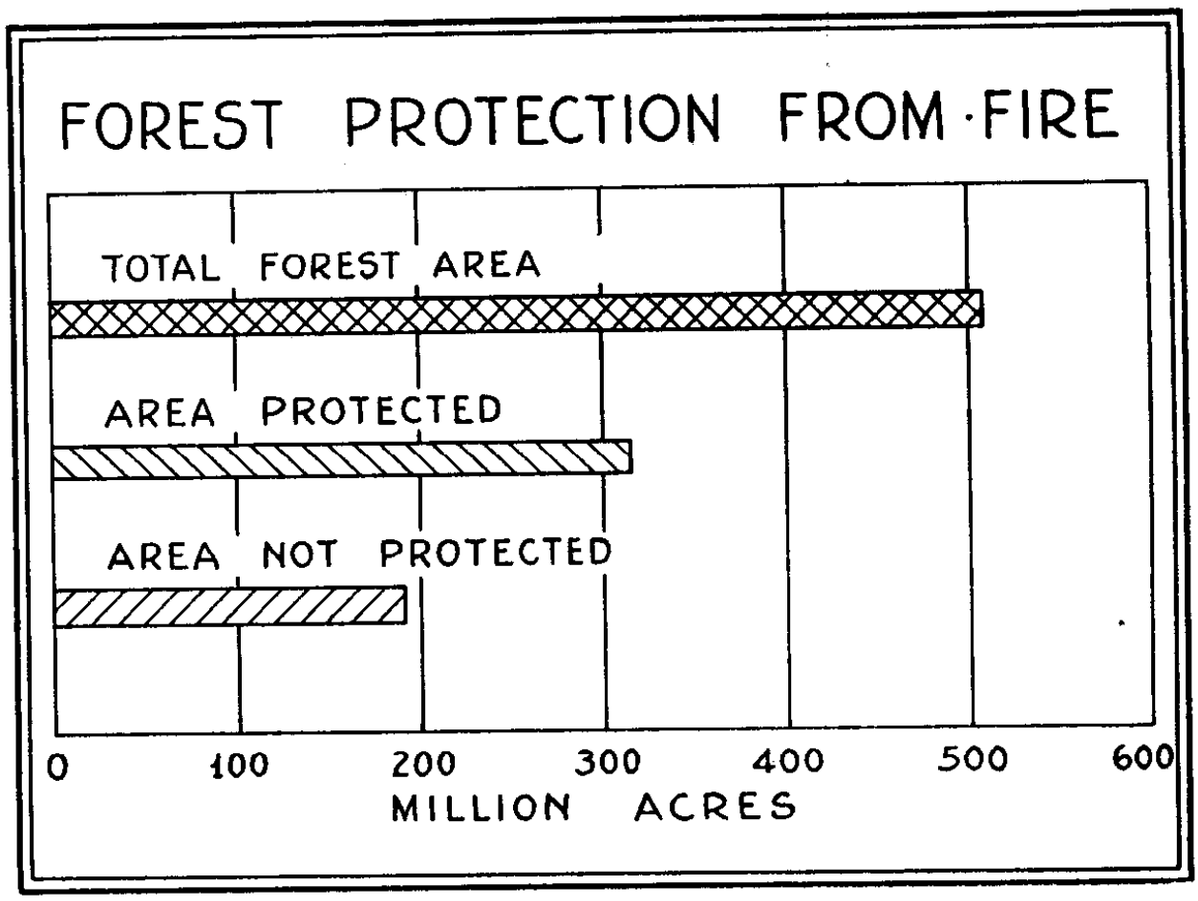

Fig. 23. Area of Forest Land in United States Protected and Not Protected from Forest Fires (1935).

ficial records show that in 1931, 100 per cent of the forest area of New England, Pennsylvania, New Jersey, Delaware, Maryland, Michigan, Wisconsin, Minnesota, Oregon, Washington and a few other states was given protection against forest fires. Other states with the percentage of their total forest area given protection against fire are: California (99%), Idaho (96%), New York (88%), Tennessee (68%), Texas (46%), Louisiana (30%), Florida and Georgia (8%), South Carolina (5%), and Mississippi (3%). In the South, with 206,321,000 acres of forest land requiring protection, only about 51,476,910 acres are given some form of protection. This is less than 25 per cent of the total area of forest land.

4. *The national government, the states and other public and private agencies are assuming more and more responsibility in the prevention and suppression of forest fires.*

5. *The forest fire control personnel has been increased greatly in number and efficiency in recent years.*

In addition to the regular personnel, the U. S. Forest Service now employs more than 4,000 forest guards who work during the

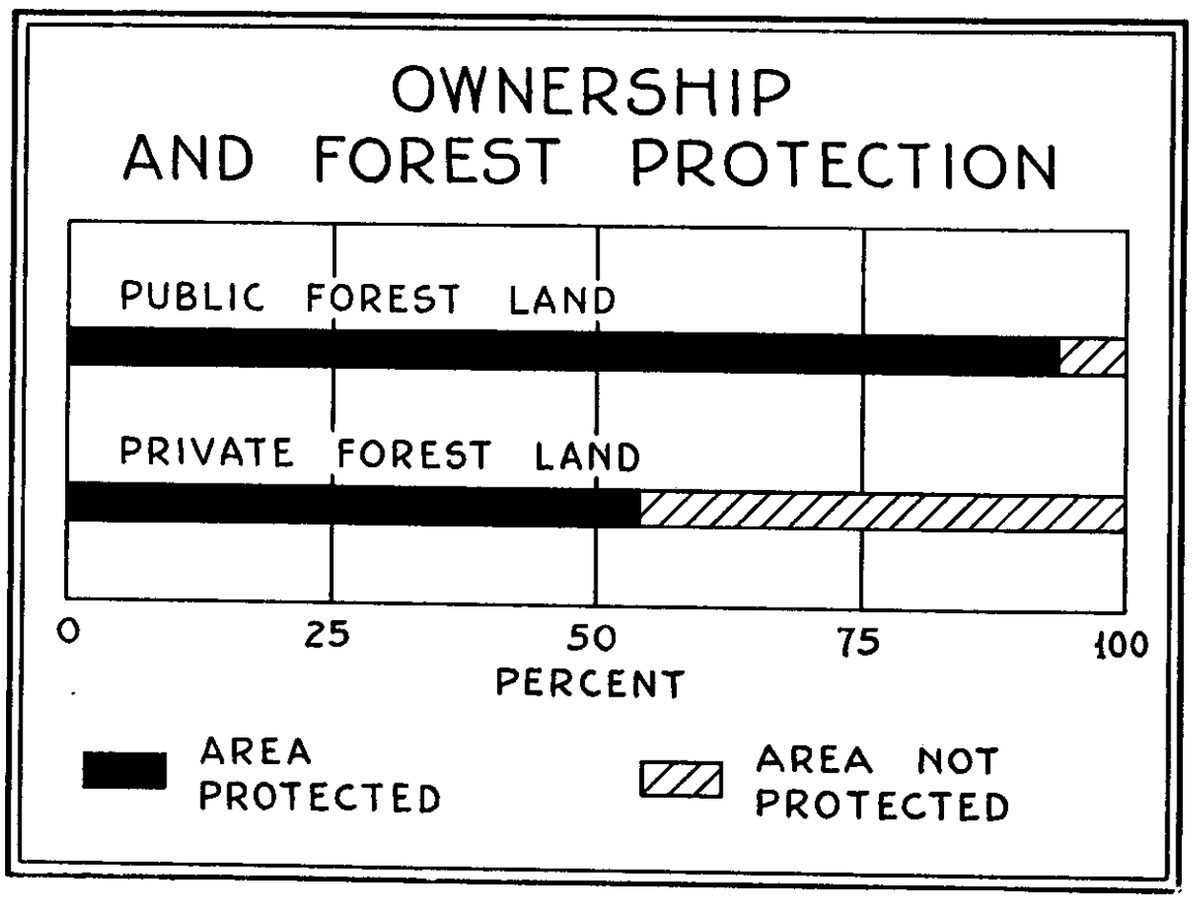

Fig. 24. Extent of Protection of Forest Land in United States on Basis of Ownership (1935).

forest fire seasons. Many states now have from 30 to 145 forest tower observers, and some states have as many as 4,000 forest fire wardens. Trained wardens and organized fire fighting crews are rapidly replacing volunteer forest fire fighters. The personnel of the C.C.C. Camps has been a great help in forest fire control work.

6. *Better forest fire prevention, detection and extinction methods are now in use.*

The whole technique of handling the forest fire problem has been thoroughly revised and greatly improved. Policies have been reworked, programs enlarged and practices modernized. Backfiring, that is, fighting fire with fire, is still the commonest method of fighting surface forest fires, but in recent years great advances have been

made in the use of water by means of special pumps and also in the use of chemical fire extinguishers from airplanes. Controlled burning is recommended in a number of forest regions for special purposes and under special conditions.

7. *Much more and better forest fire control equipment and supplies are now available.*

The new and improved equipment and supplies consist of towers, cabins, tools, tanks, pumps, trucks, tractors, airplanes, and radios (several thousand sets now in use on the national forests.)

8. *More and better forest roads, trails, telephone lines and other forest improvements are now in use.*

9. *Larger and more dependable appropriations for forest fire control are assured.*

10. *Better forest fire laws are getting on the statute books, and law enforcement is becoming more effective.*

11. *More active and effective cooperation in forest fire control between public and private agencies is in progress.*

12. *Better public and professional understanding and support of the whole forest protection program is developing rapidly.*

Without continuous and effective public support, forest fire control work cannot accomplish the results needed for our general welfare. The complete exclusion of fire from the forest is rarely attainable, but forest fire control should be planned on a reasonably intense and permanent basis so as to serve the best practical and the soundest social betterment purposes of forest conservation.

IV. SOME HISTORIC FOREST FIRES

Forest fires sometimes reach gigantic proportions and attain historic importance. One of these historic forest fires is the Miramichi fire of 1825. It started at one o'clock in the afternoon of October 7 about 60 miles above the town of Newcastle on the Miramichi River, in New Brunswick. Before 10 o'clock that night it was 20 miles below Newcastle. Within nine hours it covered an area 80 miles long and 25 miles wide, that is, somewhat in excess of two and one-half million acres. Five hundred and ninety buildings and several towns were destroyed and 160 people perished.

The Peshtigo fire of October, 1871 was even more severe and destructive. It covered an area of about 2,000 square miles in Wisconsin. Between 1,200 and 1,500 people perished. Among the most destructive forest fires of which records are available is the Hinckley fire

of Minnesota. It started on Sept. 1, 1894. Hinckley and six other towns were destroyed. About 500 lives were lost and several thousand additional persons were left destitute. The estimated loss of property was $25,000,000.

The Priest River fire of 1931 in northern Idaho is among the big forest fires of recent years. It started outside the national forest boundary at 11 A. M. on August 3, and "crowned" immediately. Within an hour it was 2 miles long and 1 mile wide and in the early afternoon was racing on a front of 5 miles, with a length of 15 miles. By nightfall, when the wind dropped, it had destroyed 34 ranches, blocked two highways with burning timber and trapped a hundred people. By midnight 700 men were attacking it, and by noon of the next day 1,500 men were on the fire line. Within five days the tremendous job of building 90 miles of line around this fire in dense standing and down timber and rugged mountain country, along steep slopes, was completed; but six weeks of "mopping up" and patrol were required before the fire was considered safe.

Among recent serious forest fires is the Tillamook Conflagration of Oregon in August, 1933. The Tillamook fire was the most destructive in Oregon in 65 years. It burned for eleven days, covered more than 300,000 acres, and destroyed the finest stand of timber that was left in Oregon. The estimated total damage of this fire is more than $200,000,000. One human life was lost and a score received serious injuries. Three thousand men battled with the fire, which scattered ashes and burned needles and bark over the cities of the Pacific Northwest.

V. FOREST FIRE LEGISLATION

As early as July 26, 1631, the setting of fires, except within a certain portion of the year, was forbidden in the Massachusetts Bay Colony under the pain of paying damages and such a penalty as the court should see fit to impose. The first forest fire laws pertained primarily to the loss of life and property, but as early as January 15, 1743, a Massachusetts act also mentions damage by fire to young tree growth and to the soil. A New York act of December 17, 1743, which applied only to four counties, empowered any person discovering a fire in the woods to summon all neighbors to assist in extinguishing it. A penalty of six shillings was imposed on any person who refused, neglected, or delayed to help. Fifteen years later (1758) this act became state-wide in its application. After the advent of the steam railroad in America (1830-1850) many forest fire laws were passed imposing liability for damage resulting from locomotives and employees. These acts appeared in large numbers from 1870 to 1885. On May 15, 1885 an act was

passed in New York providing for the care and protection of the forest preserves. It provided compensation for those who helped fight fires, the maximum pay being two dollars per day for wardens and one dollar for others. Between 1885 and 1900, twenty-six states passed forest fire legislation and even more rapid development took place after 1900. Only eleven states had no forest fire legislation in 1916. Now there are hundreds of laws of forest fire prevention and suppression on the statute books covering practically all phases of forest fire control conditions and activities.

VI. THE BIGGEST FOREST FIRE PROBLEM

The biggest forest fire problem today is the prevention of man-caused fires, and this means fully ninety per cent of all the forest fires that burn in this country. In spite of 25 years of educational effort the number of man-caused fires is still surprisingly high. To make possible effective forest management, there is need for a greatly improved public attitude towards the forest fire situation. One of the requirements for the attainment of better protection of the forests against fire is more and better forest fire research. Any forest fire program must be built on the certainty of the continued occurrence of forest fires resulting from human occupancy and use.

QUESTIONS

1. What are the principal agencies that damage the forest?
2. How many fires occur annually in the United States? Approximately what total area do they burn over?
3. Name and describe briefly the four principal kinds of forest fires.
4. List the principal causes of forest fires. Do the causes vary in different parts of the United States?
5. What are the principal forest fire seasons? Do they vary in different parts of the United States?
6. Discuss the effects of forest fires.
7. What progress has been made in the control of forest fires?
8. What are the principal agencies now engaged in forest fire control?
9. In what way do roads, trails, telephone lines, and observation towers help in forest fire control?
10. How much money is spent annually in the United States on forest fires?
11. Describe briefly a few historic forest fires.
12. Discuss the changing attitude of the public towards forest fires from colonial days to the present time.

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Author's Note: Lantern slides showing the effects of forest fires and illustrating all phases of forest fire control work can be obtained from the U. S. Forest Service and most state forestry departments. Excellent motion pictures on forest fires can be obtained from the U. S. Forest Service and some state forestry organizations. Exhibit and other display material is also available for use by schools and other educational agencies.

Chapter XV

FOREST ENEMIES OTHER THAN FIRE

Our forests have a multitude of enemies. Some of them are living creatures while others do not possess life. Snow and ice often break away branches and crush tree crowns, strong winds may lay low vast stretches of forest growth; shifting sands sometimes bury considerable areas of forests, and the damage that floods, erosion, drought, cold, and frost do in the aggregate is often considerable. But the damage these destructive agents do, is relatively small compared with the damage by insects, fungi, wildlife, domestic animals, and other living creatures.

I. FOREST INSECTS

Forest entomology is the science which deals with the insects that affect forests and forest products. It embraces a study of the biology of the insect; the nature of the injury and its extent; the possible measures of prevention and the control under forestry conditions.

A. Classification of Forest Insects Based on Habit

1. *Defoliators.* Those insects that injure or destroy the foliage of coniferous and deciduous trees by sucking the juices from the foliage or by chewing.

2. *Wood borers.* Those insects that bore in the sapwood or heartwood of the stem, branches and roots rendering it useless for commercial purposes.

3. *Cambium miners.* Those insects that cause the death of the tree by destroying the cambium.

4. *Gall makers.* Those insects that cause gall-like swellings to appear on leaves, twigs or the bark of the main stem.

5. *Fruit and nut feeders.* Those insects that feed upon the seed of forest trees.

6. *Oviposition injury.* Those insects that distort the tips of the laterals or the leader by cutting slits in the tissue for the purpose of laying eggs.

7. *Predators.* Those insects that feed upon other insects.

8. *Parasites.* Those insects that live on other living insects.

B. Occurrence and Extent of Insect Injury

The most destructive forest insects are the "Bark Beetles." These are small insects—the largest is not over 3/8 inch in length. One species known as the Western Pine Bark Beetle destroys annually over 1,000,000,000 board feet of western yellow pine in the State of California. The present lack of commercial larch is due to the Larch Sawfly, a defoliating insect that destroyed the mature larch throughout its entire range over 40 years ago. The Spruce budworm has destroyed millions of cords of spruce and balsam in Eastern North America in the last 20 years. The Canadian Government recently estimated their loss of timber due to the attack of insects as being seven times as great as the loss due to fire.

Trees have a continual struggle to survive their insect enemies. Even the seeds forming on the tree are attacked. Soil insects also infest the planted seeds—other soil insects destroy the roots of the seedlings and insects continue to attack the tree during its lifetime until the final crop trees are ready for cutting. Then the logs are attacked in the woods, and after they reach the mill the seasoned or partly seasoned lumber is attacked by another group of insects. and finally the finished and manufactured product is subject to attack by termites, commonly called white ants, and by powder post beetles. It has been estimated that the total annual loss of forest resources due to forest insects is more than $200,000,000.

C. Prevention and Control

1. *Natural control.* Injurious insects are often kept down by natural environmental factors such as climate, parasites, predators, disease, rodents, and birds. Man seeks to aid nature in checking a pest by rearing parasites and predators and releasing them in the vicinity of the outbreak. This is usually called *biological control.* High and low temperatures and extremes of drought and moisture also produce insect mortality. Man often makes use of these factors by using special methods of piling logs and brush disposal.

2. *Artificial control.* Two forms of artificial control are widely used, namely, special forest practices and insecticides. Much insect damage can be prevented or controlled by the application of proper silvicultural and management practices. Under ordinary forest conditions it is difficult to use and apply insecticides. In recent years a new line of attack has been used in scattering poison dust by airplanes over selected forest areas for insect control purposes.

II. FOREST TREE DISEASES

Forest pathology is that science which is concerned with the diseases of forest trees, their prevention and control, and their effects upon the forest. As used today this term includes not only a study of those conditions which destroy forests and impair their usefulness to man, but also their effect on forest products through such processes as decay of structural timber, blue stain of lumber and deterioration of paper pulp.

Tree diseases affect the productiveness of forests in three ways: (1) by killing trees, (2) by reducing tree growth, and (3) by destroying completely or lowering the usefulness of wood and other tree products. Forest tree diseases also reduce the value of forest areas for recreation, for watershed protection and for wild life management, and they contribute heavily to the creation of forest fire hazards.

A. Many Different Kinds of Tree Diseases

Many different kinds of fungi attack forest trees beginning with the sprouting seeds and continuing to the very end of a tree's life. For a general consideration of forest tree diseases it is possible to group them according to the age of the trees affected.

1. *Diseases affecting nursery stock.* The most common disease affecting forest tree nursery stock is known as "damping off." The fungi causing this serious trouble attack the seedlings from the time the hypocotyl first emerges from the seed coat until they are two to three weeks old. Root rot of older seedlings is also a serious nursery disease and locally needle diseases are common. The latter are responsible for great losses of longleaf pine seedlings in the South. Information is generally lacking concerning the great loss of natural seedlings in the forest.

2. *Diseases affecting plantation stock.* A large number of different diseases attack trees in forest plantations, some of which may become serious. Among the common plantation diseases can be listed the blister rust of white pine, the brown-spot needle disease of longleaf pine, the needle rust of red pine, the sweet fern rust of Scotch pine, and the blight of spruce and fir in the Northeast.

3. *Diseases affecting immature forest stands.* Perhaps rust fungi and the mistletoes are responsible for most of the damage to immature forest stands. Blister rust may kill up to 100 per cent of the white pine trees in a young forest. The U. S. Forest Service considers the white pine blister rust as the most serious tree disease threatening the national forests. It made its first appearance in the East, where it was introduced on nursery stock early in the present century. It is also widely distributed in the West, where it was first

introduced into British Columbia directly from Europe in 1910. It attacks only the five-needle pines, of which the three most important are the eastern white pine, the western white pine, and the sugar pine of California.

The dwarf mistletoes of the West do enormous damage to conifers by reducing growth and killing trees outright. These dwarf mistletoes are entirely different from the holiday mistletoe of the East. They have no leaves and few conifers are free from their attack. A normally stocked stand of 50 year-old Ponderosa pine in California, moderately infected with dwarf mistletoes was 14 per cent ruined by stem infection and a heavily infected stand had 100 per cent of the trees attacked and 80 per cent ruined. It is gradually becoming known that the aggregate loss from disease in immature forest stands destined for timber production is quite high, and that it probably approaches or exceeds the losses caused by decay in mature stands.

4. *Diseases affecting merchantable forest stands.* Parasitic fungi and mistletoes are responsible for heavy annual losses in merchantable forest stands, but the great loss from fungous action in this type of stand is caused by what are commonly called decay fungi. They destroy the heartwood of living trees. Recent studies show that in Douglas fir, which composes one-third of the remaining sawtimber of our country, the loss due to decay amounts to 17 per cent of the stand. In the Adirondack region of New York beech is often of doubtful value because of extensive decay, and in the bottomlands of Louisiana this tree is often left standing as worthless in logging operations because of excessive decay. In the old coniferous forests of northern Idaho many species are so heavily attacked by decay that they are largely unmerchantable.

B. Introduced Forest Tree Diseases

Some of the most destructive forest tree diseases have been imported from other countries. The chestnut bark disease, which has destroyed practically all the chestnut of commercial size throughout its entire range, was imported from China. The white pine blister rust, unquestionably one of our most serious tree diseases, was imported from Europe, and during the past few years the troublesome Dutch elm disease, also imported from Europe, has progressed so rapidly and destructively that all the elms of the East are threatened. Other introduced tree diseases are the willow blight, the larch canker and resinosis of pine.

C. Control of Forest Tree Diseases

1. *By exclusion.* By means of domestic and foreign quarantines tree diseases can be excluded from this country and kept localized within it. This work is organized under the Federal Bureau of Entomology and Plant Quarantine.

2. *By eradication.* Eradication is a widely used type of control, which aims to destroy the organisms causing the disease, their hosts or their alternate hosts. Typical examples are eradication of Ribes (currants and gooseberries) to protect white pine from blister rust, and destruction of elm trees affected with the Dutch elm disease fungus.

3. *By protection.* This includes the use of fungicides to protect trees against leaf disease fungi, also proper pruning, improved logging methods to prevent bark wounds, and protection against fire to prevent fire scars and subsequent decay.

4. *By immunization.* This includes the development of immune strains of trees. An example of this is the breeding and crossing of chestnuts to get strains resistant to or immune to the Chestnut Bark Disease.

Forest Pathology is becoming an important phase of forest protection. It considers not only the diseases of trees but also the deterioration of killed timber and the deterioration of forest products by two distinct groups of microscopic fungi, namely, the stain and mould fungi and the decay fungi.

III. WILDLIFE

Among the wild animals that do considerable damage to the forest are beaver, deer, porcupine, rabbits, squirrels, mice, and birds.

A. Beaver

Beaver kill a large number of trees by girdling and felling them. Entire stands adjacent to their dams are often killed by the water level being raised above the height the trees can tolerate.

B. Deer

In those regions and localities having a high deer population, the damage done by them is often enormous. As early as 1925 field studies showed excessive forest damage by deer in several localities in Pennsylvania. In a few national forests in the Southwest the deer problem became serious a decade or more ago. A recent study shows that there are 15,000 acres in one county in Pennsylvania that have been damaged so heavily by deer that an adequate forest growth can be restored only by planting, and plantations of 10,000 to 50,000 trees that have been completely ruined by the deer are not uncommon. In other states the deer damage problem is also becoming acute.

C. Porcupines

Tree damage by porcupines is common over a wide region. The damage consists in the gnawing of the bark on living trees.

Many trees die as a result of the gnawing. As a control measure on 2,200,000 acres of national forests in California in 1934, 12,827 porcupines were shot, almost 17,000 trees blocked, 5,900 dens treated, and 3,300 pounds of poison salt distributed.

D. Rabbits

During the winter months rabbits gnaw the bark of trees, often completely girdling and killing them. In some localities they do damage chiefly to young forest growth. In many plantations in the Lake States they have developed into a real menace. During the winter of 1933-34 an intensive control campaign was undertaken by the U. S. Forest Service with the aid of the boys of the Civilian Conservation Corps.

E. Squirrels and Chipmunks

Considerable damage is done by squirrels and chipmunks in destroying tree seeds and biting off buds and young twigs.

F. Mice, Rats and Gophers

Mice do a great deal of damage to small trees, especially in nursery beds. They also destroy large quantities of seed and young reproduction. Locally rats and gophers do considerable damage to tree growth.

G. Birds

Some birds do considerable damage, but on the whole their benefits outweigh their damage. In forest tree nurseries birds are very troublesome, particularly during the migrating season, when they feed freely on freshly sown seed. Some birds feed freely on buds, twigs, tree seeds and fruit.

IV. DOMESTIC ANIMALS

In the aggregate enormous damage is done to the forest by domestic animals, such as cattle, horses, mules, burros, sheep, goats and swine. The damage by cattle is most common in the woodlots in the agricultural regions. In some places forest reproduction is practically impossible because of grazing. The effects of grazing are not limited to reproduction but extend to soil damage, and browsing of branches and terminal shoots. Sheep damage is most common on the large sheep ranges of the West.

V. INORGANIC AGENCIES

Locally considerable forest damage is caused by wind, snow, ice, frost, cold, heat, drought, floods, erosion, and shifting sands. Records are available of destructive wind storms in the forests of the United States and also in the intensively managed forests of central Europe. Wind storms are most destructive in evergreen

forests. Snow and ice damage are usually greatest when the temperature is at or near the freezing point over a prolonged period and accompanied or followed by strong winds.

QUESTIONS

1. Name the principal enemies of the forest other than fire.
2. What are the principal kinds of damage done by forest insects? How extensive is forest insect damage?
3. What methods are used in controlling forest insect damage?
4. What is forest entomology? forest pathology? forest zoology?
5. Name the three principal ways that tree diseases affect the productiveness of forests.
6. Describe briefly the principal groups of tree diseases based on the age of the trees affected.
7. What control measures are used against forest tree diseases? Are all forest tree diseases native?
8. List some common wild animals that damage forest trees and describe the nature of the damage.
9. Under what conditions do domestic animals damage forest trees?
10. What inorganic agencies damage forest trees?

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Author's Note: A large number of federal and state bulletins, circulars and other pamphlets have been published on forest insects, forest tree diseases and forest wild life. Lantern slides, motion pictures and other illustrative material can be obtained from the U. S. Forest Service, the U. S. Bureau of Plant Industry, the U. S. Bureau of Entomology and Plant Quarantine, the U. S. Biological Survey and state forestry and conservation organizations.

CHAPTER XVI

THE PRODUCTION AND CARE OF FORESTS

I. WHAT SILVICULTURE IS

A. The Meaning of Silviculture and Silvics

The art of producing and tending a forest is known as *silviculture.* Graves defines silviculture as "the art of establishing, developing and reproducing forests." A knowledge of *Silvics* or *Forest Ecology* which deals with the underlying principles controlling the life of forest trees and stands, is a prerequisite of the study of silviculture and its effective application. The field of silviculture may be divided into the following two major divisions:

1. The treatment of trees or stands during the period of reproduction (regeneration) or establishment—*Reproduction Methods.*

2. The treatment of trees and stands during their development other than the period of reproduction—*Stand Improvement Measures* or *Intermediate Cuttings.*

B. Reproduction Methods

Reproduction methods are orderly processes or practices by which forest stands are renewed or established, either by natural or artificial means. The three principal means of reproduction are:

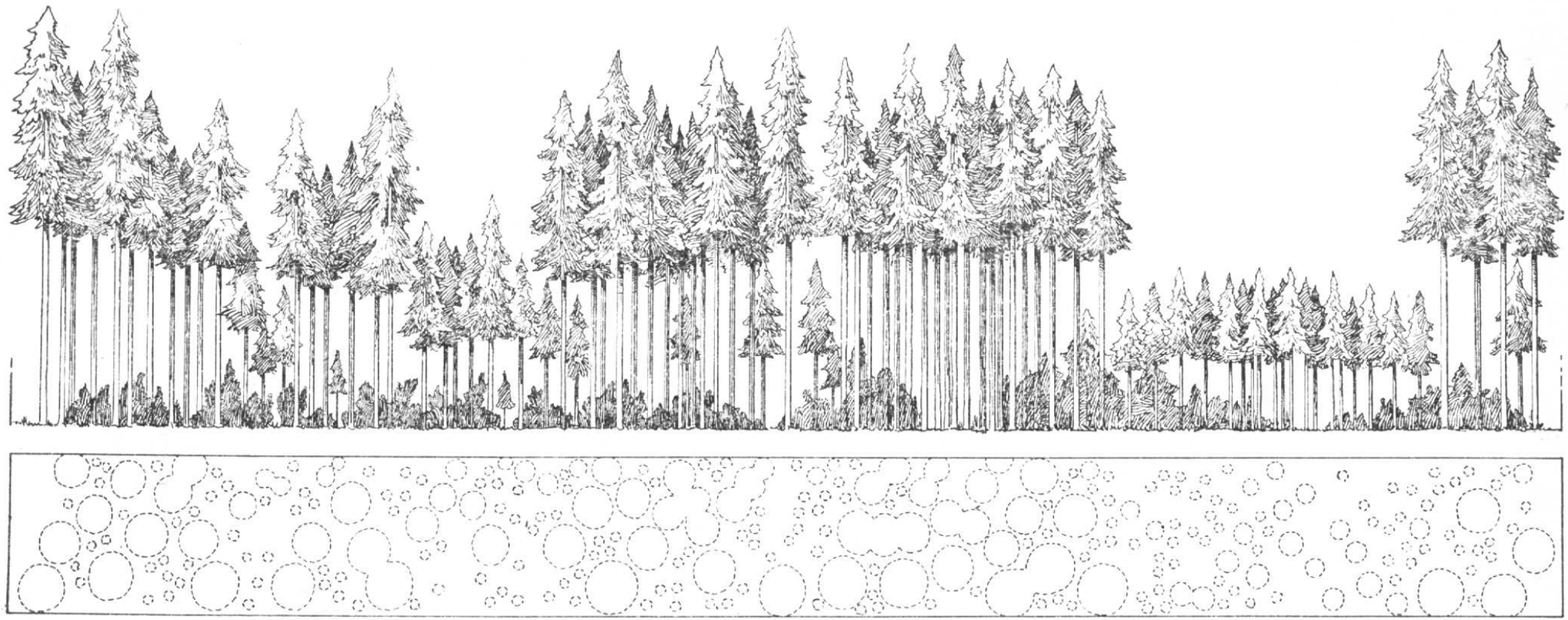
1. Natural, that is, from self-sown seeds, sprouts, suckers and natural layers without assistance of man.

2. Artificial, that is, from seeds or plants brought to the site by man.

3. A combination of natural and artificial means of reproduction.

Many different reproduction methods have been developed (some authorities list as many as 70) but the most important methods are:

1. Clearcutting:
   a. with natural reproduction
   b. with artificial reproduction
2. Seed-tree
3. Shelterwood
4. Selection
5. Coppice
6. Coppice with standards



Courtesy of U. S. Forest Service.

Fig. 25. A Group Selection Forest.

C. Stand Improvement Measures (Intermediate Cuttings)

The treatment of forest stands during their development, other than the period of regeneration, is now generally called stand improvement measures (also intermediate cuttings). According to Toumey a forest stand is a more or less limited area of forest so uniform in character as to call for a separate or particular method of treatment. The primary purpose of stand improvement work is to bring rundown and inadequately productive forest stands into better condition for wood production, watershed protection and soil conservation. The principal kinds of stand improvement measures are:

1. *Cleaning* (weeding, assistance cutting, release cuttings). A cutting made in a stand not yet past the sapling stage for the purpose of removing shrubs, vines, and trees of undesirable form or species that are injuring or are likely to injure promising trees.

2. *Thinning.* A cutting made in a dense immature stand after the sapling stage for the purpose of increasing the growth rate of the trees that are left and of improving the composition and quality of the stand.

3. *Improvement Cutting.* A cutting in a forest that has passed the sapling stage (second growth or old growth), the main object being to remove trees of undesirable form, condition, and species.

4. *Liberation Cutting.* A cutting made for the purpose of freeing desirable trees in the under-story of the forest by removing undesirable overtopping trees (wolf trees).

5. *Salvage Cutting.* A cutting made for the purpose of removing trees killed or damaged by destructive agencies, such as fire, insects and fungi.

6. *Pruning.* A cutting which removes branches (usually the lower) chiefly for the purpose of increasing the quality of the wood.

II. REFORESTATION

Reforestation in its broadest meaning is the natural or artificial restocking of an area of land with forest trees. Other terms closely related to reforestation are afforestation, forest reproduction, forest regeneration, forest restoration, planting, replanting and seeding. In its commonest usage reforestation refers primarily to the artificial restocking of existing forests and open land areas such as abandoned fields. If a distinction is desired between "reforestation" and "afforestation," the former is used to designate the planting of previously wooded areas, and the latter to designate areas that have always or for a considerable time been without a forest growth, such as prairies or abandoned fields.

A. Artificial Reforestation

1. *Direct seedings*:
   a. Broadcasting
   b. Strip and block sowing
   c. Seed spotting.
2. *Planting*:
   a. With wildling stock
   b. With nursery-grown stock.

B. Forest Tree Nurseries

A forest tree nursery is an area of land upon which young trees (rarely older than 5 years) are grown (usually from seed) for forest planting. In general appearance and layout, forest tree nurseries resemble gardens, being divided into seedbeds and transplant beds. Among the most important essentials of a forest tree nursery is a suitable site with proper soil and adequate water supply. Among the principal nursery activities are:

1. Preparing seed beds
2. Sowing seeds
3. Shading young seedlings
4. Watering
5. Weeding
6. Controlling pests
7. Transplanting
8. Lifting, sorting, bundling and packing of planting stock.
9. Shipping and storing of planting stock
10. Taking stock inventories

The U. S. Forest Service now (1939) operates twenty-six forest tree nurseries with an approved total annual output of approximately 171,800,000 seedlings and transplants. The largest federal forest tree nurseries are the W. W. Ashe in Mississippi and the Wyman and the Chittenden in Michigan, each with an annual output of approximately 20,000,000 trees. The U. S. Soil Conservation Service, the Prairie States Forestry Project and most states operate forest tree nurseries. New York leads all other states in the production and distribution of forest tree planting stock. In 1936, 72,890,000 trees were distributed from the state nurseries of New York. In 1938 the tree distribution dropped below 27,000,000.

C. Kinds of Planting Stock

The principal kinds of planting stock grown in forest tree nurseries are: *seedlings* and *transplants*. They are usually grouped into the following size and age classes:

Age Classes	*Designation*
One-year seedlings	1-0
Two-year seedlings	2-0
Three-year transplant (Two years in seed-bed and one year in transplant bed)	2-1
Four-year transplant (Two years in seed-bed and two years in transplant bed)	2-2

Forest tree seedlings and transplants are usually small in size. A one-year old white pine seedling rarely exceeds several inches in height above the ground line and a four-year old spruce transplant is usually not over 2 feet in length including the roots. Because of their small size, forest tree seedlings and transplants can be grown in large numbers on small areas of nursery beds. In a nursery bed 25 feet long and 4 feet wide (100 square feet) it is not difficult to grow from 8,000 to 10,000 two-year old white pine seedlings. A ten acre forest tree nursery has been producing from two to four million *seedlings* annually over a ten-year period.

D. Seed Collection, Extraction and Storage

An enormous quantity of forest tree seed is required annually to supply the needs of the nurseries. Each year, but especially in heavy seed years, seed collecting crews are organized and operate for weeks at designated places in the forest. After collecting the cones, acorns, and burrs it is necessary to provide means for extracting the seeds from them. Most organizations now have special means for extracting the seeds from them—seed extracting plants, and after the seed is extracted it is necessary to make proper provisions for storing it until needed. Special containers and other facilities have been developed for this purpose, including cold storage.

Among the most important problems in the whole field of reforestation is the source and quality of forest tree seed. Some certified forest tree seed is gradually finding its way into use. Special forest tree seed supply stations (orchards) have been established and are being developed for the purpose of producing quality forest tree seed.

E. Forest Tree Planting

Five important questions present themselves in connection with any forest tree planting program. They are:

1. Why plant
2. Where to plant
3. What to plant
4. When to plant
5. How to plant

Helpful information pertaining to these questions is available in numerous books, bulletins and pamphlets. State forest officers and extension foresters are regularly supplying much helpful information about forest tree planting in all parts of the United States.

F. Extent of Reforestation

Reforestation has been increasing rapidly in recent years, especially in the eastern, the southern and the lake states. In 1936, almost 225,000 acres were planted and sowed on the national forests. The same year almost seventy-three million forest trees were distributed from the state nurseries of New York. Most of the forty-two states that now have administrative setups for forestry do some reforestation work. In addition to public agencies many private concerns are now planting forest trees. In 1936, more than seventeen million forest trees were planted by private agencies in New York

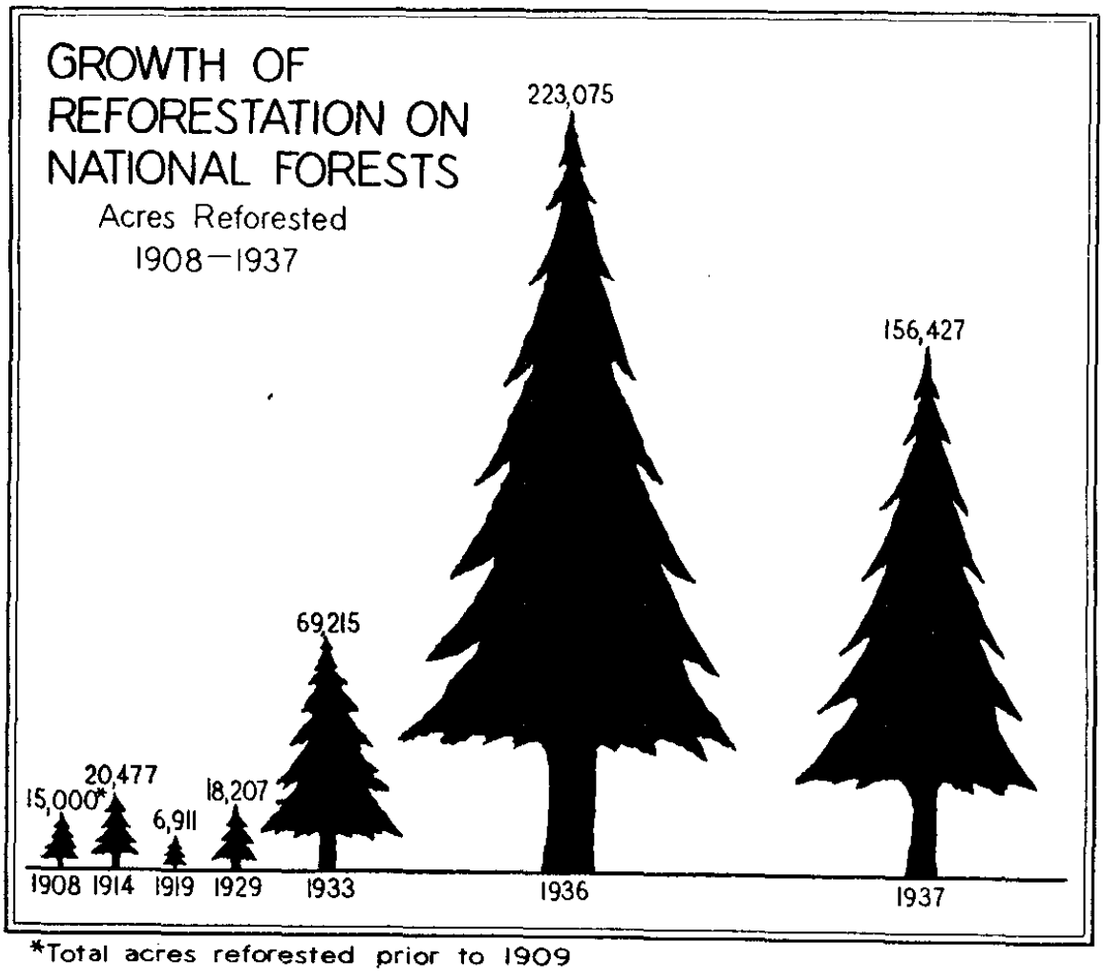


Fig. 26. Growth of Reforestation on National Forests.

State alone. The late T. C. Luther of Mechanicsville, New York is credited with being the largest individual forest tree planter in the United States, having planted more than 6,000,000 seedlings and transplants from 1916 to 1929 on his 6,500 acre preserve. In 1935 Mr. Luther wrote: "To me the most interesting fact about our Forest Preserve is that since 1916 we have followed a well defined plan of management looking towards sustained yield at the time that the plantations begin to mature."

G. Spacing in Forest Tree Planting

The usual spacing distance is from 4x4 to 6x6 feet. The number of trees required per acre for the different spacing distances follows:

Spacing Distance (feet)	*Number of Trees Per Acre*
4x4	2,722
5x5	1,742
6x6	1,210
8x8	681

H. Cost of Reforestation

The cost of reforestation varies widely. A good average figure is however, from $10 to $15 per acre including planting stock. The production cost of planting stock ranges from $1.00 to $4.00 per

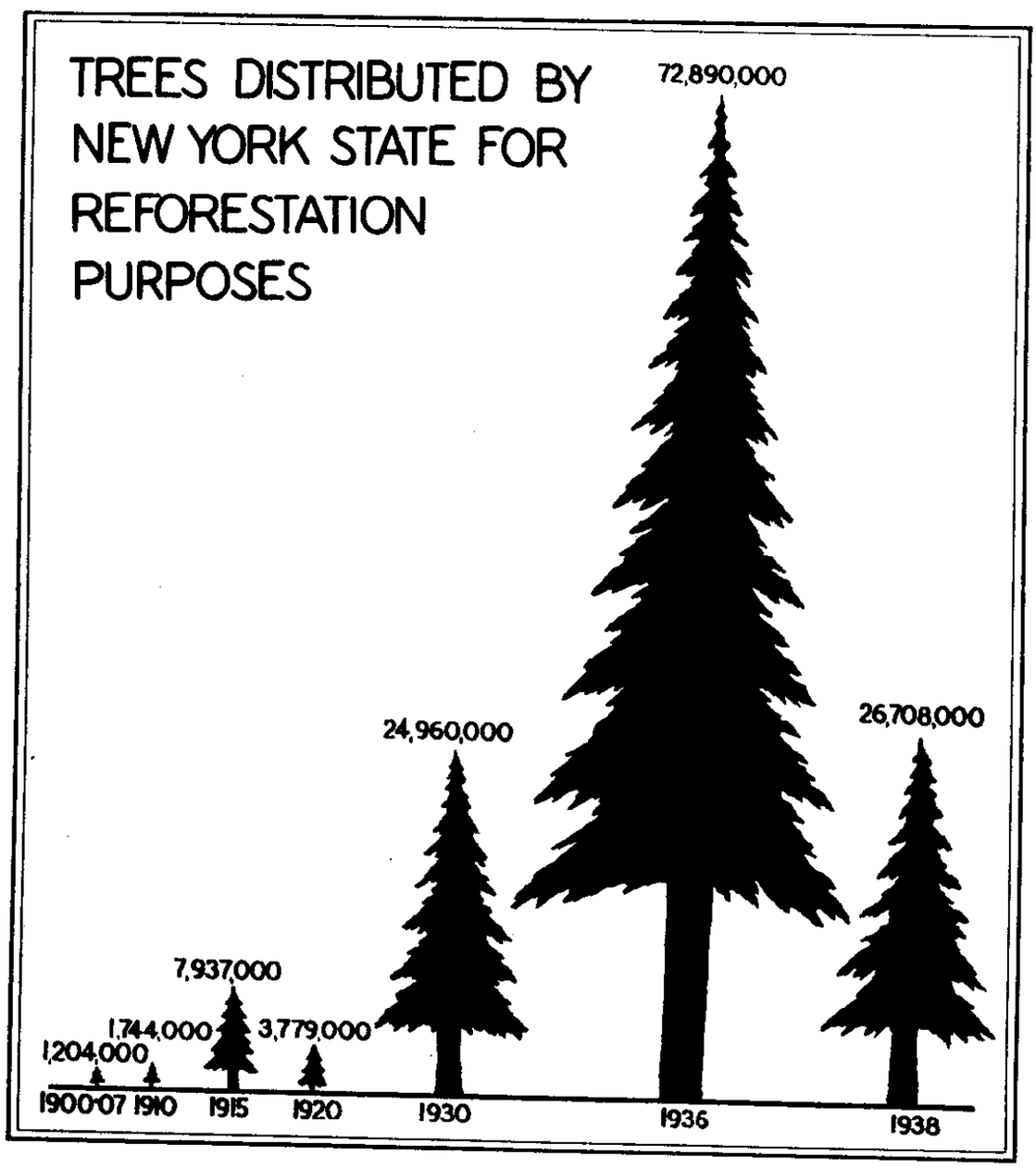


Fig. 27. Trees Distributed by New York State for Reforestation Purposes.

thousand for seedlings and from $3.50 to $5.00 per thousand for transplants. The actual planting cost usually ranges from $6.00 to $10.00 per acre. On average planting sites a crew of two men can plant from 500 to 1,000 or more trees per day.

I. Principal Agencies Engaged in Reforestation

The principal agencies engaged in reforestation are the federal government, the states, counties, municipalities, communities, schools, corporations, and individuals. Until recently the federal government progressed slowly in its reforestation work. Most progress was made by the states, particularly those of New England, and the Middle Atlantic regions. In recent years considerable progress in forest tree planting has been made in the Lake States and in the South. The tree distribution in New York for 1937 follows:

Tree Planting	*Number of Trees Planted (1937)*
State Lands	13,943,595
Municipalities	2,862,500
Industrials	136,800
Schools and Colleges	26,500
Boy Scouts	32,900
Miscellaneous organizations	571,372
Individuals	7,446,225
TOTAL	25,019,892

III. HISTORY OF REFORESTATION

A. In Europe

Reforestation began more than 500 years ago. The first authentic record of reforestation is that of the city of Nuremberg, Germany. In 1368, several hundred acres of burned-over land were sowed with pine, spruce and fir seed. The tree crop grown from this seed was harvested in 1449. The planting of the first hardwood trees followed more than 100 years later. The first reference to hardwood planting is credited to the cloister and city of Seligenstadt, Germany, which in 1491 agreed to reforest annually 20 to 30 acres with oak. Although sporadic attempts at seeding and planting were made as early as the 14th century, extensive artificial reforestation did not begin until the middle of the 18th century. The oldest existing examples of extensive reforestation are found in central Europe, particularly in Germany, Austria, France and Switzerland.

B. In United States

More than 100 years ago a few sporadic attempts at reforestation were undertaken in the United States. As early as 1827 the government attempted to grow live oaks in the southern states. Here and there individuals established arboretums and small plantations.

Most of the planting material used at first was wildling stock, that is, trees dug up in or near the forest. Practically no nursery-grown stock was available then. Following the establishment of Arbor Day in 1872, some reforestation on a small scale was done here and there. For about ten years following the Timber Culture Act of 1873 considerable planting was done in the prairie states, but little of it comes within the present meaning of reforestation.

Reforestation, as we understand it today, began in the United States about 1900, chiefly in the New England and Middle Atlantic States. Even then most of the planting stock had to be imported from Europe, for no nurseries were then in operation. The oldest private forest plantation in New York State was established in 1870 near Woodgate in Oneida County. The first trees planted on the forest reserves of Pennsylvania were set out in 1899, and the next year (1900) the first trees were planted on the forest preserves of New York. The first year's planting in Pennsylvania totalled 1,000 trees and during the second year (1900) 1,500 trees were planted. The first five years (1899-1903) the total planting was only 9,100 trees. This total stands in strong contrast with the present average annual planting of 8 to 10 million trees. From the planting of a few thousand trees on the forest preserves of New York in 1900, reforestation has grown by leaps and bounds until now from 25 to 40 million trees are distributed annually from the state forest tree nurseries.

IV. DISTRIBUTION OF FOREST TREE PLANTING STOCK BY STATES TO PRIVATE PLANTERS

Many states now have in operation a liberal plan for providing trees for reforestation to private tree planters. New York began in 1908. Pennsylvania followed in 1910. Most of the states are making the trees available at the cost of production, which usually ranges from $1.00 to $5.00 per thousand trees depending upon the kind, size and age. This forest tree distribution program on the part of the states has been aided considerably by the federal Clarke-McNary Law, which makes special allotments to states that are promoting reforestation.

V. ENLARGED REFORESTATION PROGRAMS

Throughout the United States enlarged reforestation programs are being placed in operation and additional programs are in the process of formulation. On November 3, 1931 the people of New York State by a constitutional amendment approved an appropriation of $19,000,000 for the purchase and reforestation of a million acres of land over a period of eleven years. This is the most compre-

hensive and far-reaching reforestation program undertaken to date in America. Since the approval of this amendment $3,240,000 have been appropriated for this reforestation program in New York, and almost 300,000 acres of reforestation areas have been acquired.

According to the Copeland Forestry Report of 1933 the area that must be considered for planting in the United States includes 83,000,000 acres of non-stocked or poorly stocked forest land. There are also 55,000,000 acres of abandoned sub-marginal agricultural land, making a total of 138,000,000 acres. It is estimated that 47,000,000 acres of this total will restock naturally within 20 years, and 68,000,000 within 40 years, leaving unstocked balances of 91,000,000 and 70,000,000 respectively in need of planting. A 20-year planting program is recommended, based on the most urgent watershed and production needs. It provides for the planting of 25,000,000 acres, nine-tenths in the East. According to the Copeland Report this proposed reforestation work will probably cost about $172,000,000 or an average of $8,600,000 for 1,276,000 acres annually. A substantial start on this reforestation program has been made, particularly by the workers of the Civilian Conservation Corps.

The most adventurous undertaking in the general field of forest tree planting was announced by President Roosevelt on July 11, 1934 in the Plains Shelterbelt Tree Planting Project in the Mid-west extending from the Canadian boundary in North Dakota for a thousand miles southward to Texas. An appropriation of $1,000,000 for the fiscal year 1934-35 was made available for this project. It is now known as the Prairie States Forestry Project.

VI. Natural Reproduction of Forests

Most forests in the United States have been and will be reproduced by natural methods. Forests reproduced by seeding and planting comprise only a small part of the total forest area. It is also significant to know that European foresters, based upon several centuries of experience and study, are now substituting natural for artificial forests. The artificial pure forests of Germany are now being transformed into natural mixed forests.

QUESTIONS

1. What is silviculture? How is it related to silvics?
2. Name the important reproduction methods used in establishing and renewing forest stands.
3. What are the primary purposes of stand improvement work? Name and describe briefly six stand improvement measures.
4. What is the province of reforestation? Compare direct seeding and planting.
5. What are the principal activities in a forest tree nursery? What is a seedling? a transplant?

6. Why is it important to use high quality seed in nursery work?
7. Give four good reasons in favor of forest tree planting. What states lead in reforestation activities?
8. How many trees are required to plant an acre if they are spaced 6x6 feet? About how much will it cost to plant an acre with forest trees?
9. In what way does the federal government and the states help private forest tree planters?
10. Is reforestation an old or a new practice? Is it progressing rapidly or slowly at present in the Unted States?
11. Discuss the enlarged reforestation programs that have been set up for the future.
12. Describe the work of the Prairie States Forestry Project.
13. Discuss the importance of natural forest reproduction.

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CHAPTER XVII

THE MANAGEMENT OF FORESTS

I. WHAT FOREST MANAGEMENT IS

Forest management is concerned with the principles and practices of handling and regulating forests. Sometimes its field of activity is so restricted that it considers only the determination and regulation of the wood yield of forests. At other times its scope is almost as broad as that of forestry itself. Between these extremes forest management usually functions, giving special consideration to such matters as land uses, land values, timber values, the cost of growing timber, the determination of yield, methods of regulating the timber cut, proper cutting practices and the preparation of working plans. These are only a few of its major activities. Sometimes forest management is called applied forestry. On the whole, it is an art rather than a science.

A. Definitions

1. Forest management is the practice or application of forestry in the conduct of the forest business—*Committee, Society of American Foresters.*
2. Forest management includes all that goes towards making the technical art of forest production successful as a business, selecting (choosing) the practical means and measures for realizing the object of crop production, namely, continuous revenue—*Fernow.*
3. Forest management determines the practicality of forestry and the conduct of the work necessary to treat the forest profitably and at the same time guarantee its continuity of production—*Graves.*
4. Forest management shows the manner and means by which the revenue producing power of a forest may be best developed—*Schenck.*
5. The whole aim in forest management is to get the greatest possible growth from our forest and at the same time leave the smallest amount of timber on the ground as a permanent capital investment—*Matthews.*
6. This problem of (forest) management involves more than raising the maximum amount of timber. In striving for that development of the forest which will yield the greatest human happiness, we are obviously after more things than trees. * * * What we are after is human happiness. * * * Our problem then is to find how we may manage our forests so as to realize their highest potentialities for the well-being of mankind —*Marshall.*

Definitions of forest management show a sustained trend away from the old narrow meaning which limited its scope practically to the regulation of the wood yield of forests. Gradually throughout

the past thirty years, and especially during the past decade, forest management has broadened its base, and now it includes regulatory principles and practices pertaining to a wide range of forest products, uses and influences. Recent definitions stress a broad human welfare and social security point of view, under which forest management concerns itself definitely with the handling of all forest resources on a sustained yield basis for the use, comfort and security of mankind.

B. Principal Kinds of Forest Management

1. Land Management
2. Timber Management
3. Recreation Management
4. Range Management
5. Wildlife Management
6. Multiple Purpose Management

C. Principal Subjects in Forest Management

1. Forest Mensuration
2. Forest Regulation (Forest Organization)
3. Forest Finance (Forest Valuation)
4. Forest Improvements
5. Forest Administration

Range Management, Wildlife Management, Land Management, Forest Engineering, Forest Improvements, and Forest Accounting and Reporting are sometimes included among the principal subjects in Forest Management.

D. Degree or Extent of Forest Management

The degree or extent of forest management can be expressed in such terms as unmanaged forests, mismanaged forests, and managed forests. The latter may be classified into extensively managed, conservatively managed and intensively managed forests. In central Europe intensive management of forest property is the rule. In the United States extensive forest management prevails.

E. Motives and Principles of Forest Management

1. Profit
2. Maximum production
3. Sustained yield
4. Multiple use
5. Cooperative management
6. Welfare

In private forestry the motive of profit and maximum production are usually stressed. In public forestry special emphasis is placed on the principles of sustained yield, multiple use and welfare. The latter principle is often expressed as the greatest good to the largest number for the longest time.

F. Forest Management and Forest Development

Some representative forest management and forest development activities are:

1. Estimating (cruising) standing timber.
2. Making forest inventories.
3. Making timber sales.
4. Marking timber for felling.
5. Marking trees for improvement cuttings.
6. Inspecting logging operations.
7. Determining charges for forest products, uses and services.
8. Preparing forest working plans.
9. Planning for sustained yield management.
10. Leasing campsites.
11. Outlining forest work programs.
12. Issuing permits.
13. Executing contracts.
14. Controlling mineral rights.
15. Inspecting property.
16. Enforcing laws, rules and regulations.
17. Acquiring, selling and exchanging land.
18. Surveying boundary lines.
19. Locating and building forest roads and trails.
20. Building dams and bridges.
21. Constructing telephone lines.
22. Caring for equipment and buildings.
23. Formulating cooperative agreements.
24. Establishing administrative field units.
25. Setting up good forest practice rules.

II. LAND MANAGEMENT

Land is basic to forest management. Without land forests cannot exist and without the use of land there can be no forest management. In any plan of forest management consideration must be given to the land, not only with reference to its natural condition but also regarding its capacities and efficiencies, for not all land has the same productive capacity nor responds equally to specific kinds of treatment.

A. Great Changes in Land Use

Ever since the whole of Manhattan Island changed hands in 1626 for $24, great changes have been taking place in land ownership and land use in this country. The Louisiana Purchase of almost 530,000,000 acres was made at less than three cents an acre. Texas (249,000,000 acres) was acquired at four cents, and Florida at fourteen cents an acre. The Great Macomb Purchase of northern New York, comprising almost 3,700,000 acres, was acquired at eight pence an acre, payable in six annual installments.

For several centuries the land shifts in this country have been away from forest land towards a wide range of agricultural uses. This extension of the agricultural use of land came at different times in different parts of the country. During certain periods of our nation's history the destruction of forests for the opening up of agricultural land went forward at an enormous rate. Gradually this

extension of agricultural land slowed down and in time the trend in land use was completely reversed. Instead of addition to agricultural land, subtraction started as long as seventy-five years ago. Already, approximately 50,000,000 acres of agricultural land have been abandoned east of the Great Plains, and it is estimated that by 1950 at least 25,000,000 more will be added. Perhaps most of this abandoned farm land will find its way back into some form of forest use.

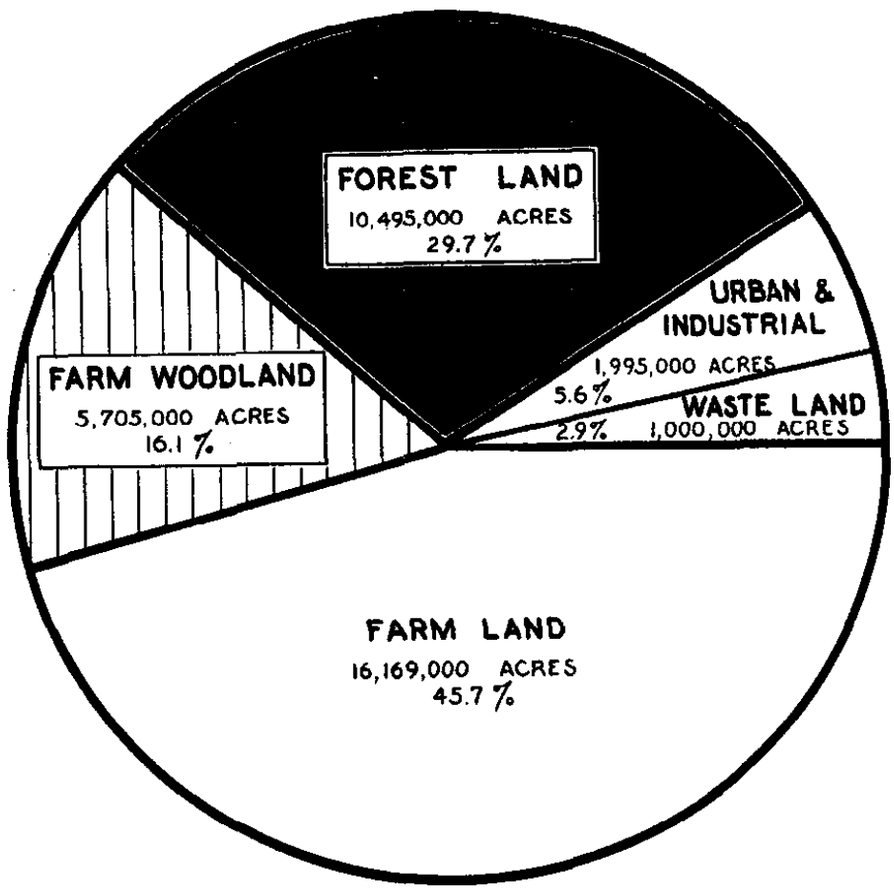


Fig. 28. Uses of Land in Wisconsin. Total Land Area of the State is 35,364,000 acres.

The past offers plenty of examples of shifts in land use based upon uncontrolled enthusiasm, selfish propaganda, wild guesses and other false stimulating factors. The future offers an opportunity to rethink the whole land problem, and develop an intelligently planned program of land classification and land use.

B. Land Classification

In recent years much progress has been made in classifying land according to its condition and its degree of usefulness for different purposes. This program is nation-wide in scope and gives promise of developing into land zoning and other regulatory measures. Step by step we are getting away from the haphazard guess-

work of the past, and developing in its place a sound and scientific plan of classifying land on the basis of its best use. In some states these land classifications have progressed far enough that anyone desiring information about land in a specific region can get it by applying to the proper federal or state agency.

C. Land Protection

The land itself, fully as much as the crops growing upon it, needs protection. Man has removed the splendid forests and other vegetative covering that nature had developed on vast areas of land. The removal of this protective covering opened the way for many destructive agencies, among them erosion. Dr. Hugh H. Bennett, Director of the U. S. Soil Conservation Service, says:

"Unrestrained erosion is rapidly building a new public domain in America—an empire of impoverished and worn-out land, land stripped of its rich surface covering or gullied beyond the possibility of reclamation. The cost to the farmers and ranchers of the country amounts to not less than $400,000,000 annually, to say nothing of the stupendous damage to highways and railways and the silting of reservoirs, streams, ditches and harbors."

D. Causes and Effects of Soil Erosion

Extensive studies show that the principal causes of soil erosion are the removal of timber, burning-over of the land, breaking up of the vegetative soil cover, cultivation of crops on steep slopes, and over-grazing of pasture land. Among the effects of erosion are washing of soil from slopes, muddying of streams, the formation of deltas and sand bars affecting navigation, the raising of stream beds with the consequent reduction of stream carrying capacity which is responsible for many floods, the silting of water storage basins and the reduction of the quality of drinking water. Many types of terraces, dams, pavings and other engineering devices are used to control erosion but permanent control is obtained chiefly through the permanent establishment of a vegetative cover. This includes the planting of grasses, vines, shrubs, and trees. Fuller details are found under the discussions of the Federal Soil Conservation Service and the state agencies active in soil conservation work.

III. TIMBER MANAGEMENT

The raising of repeated crops of timber is a main, but rarely the sole, objective of forestry. If a forest is managed as a continuing business, and in most cases it should be so managed, then it is important to give consideration to its ability to grow timber, not once but continually.

A. The Growing Stock

The existing growth material in any forest is called the growing stock. A forest without growing stock is practically bare land. The growing stock may be very heavy as in some virgin forests or it may be almost nil as on cut-over and repeatedly burned-over areas. In planting an abandoned field or reforesting a clear-cut forest, a start is made to build up a growing stock. The growing stock of most of the forests of the United States is abnormally low. Among the most important tasks of forestry is the rebuilding of the growing stock to a normal level. Not only the amount, but also the condition of the growing stock are important forest management considerations. Stand improvement measures are urgently needed in practically all the forest areas in this country.

B. The Rotation

If a timber crop of a certain size, quality or value is to be grown, it is necessary to know how long it will take to grow it. The age to which a crop of trees is allowed to grow before being cut and utilized is known as the rotation or felling age. The three important factors that determine a rotation are the species of tree, the soil and climate, and the method of forest treatment. Some rotations may be as short as 5 to 10 years, others range from 25 to 50 years, while most trees require from 75 to 100 or more years to reach timber size.

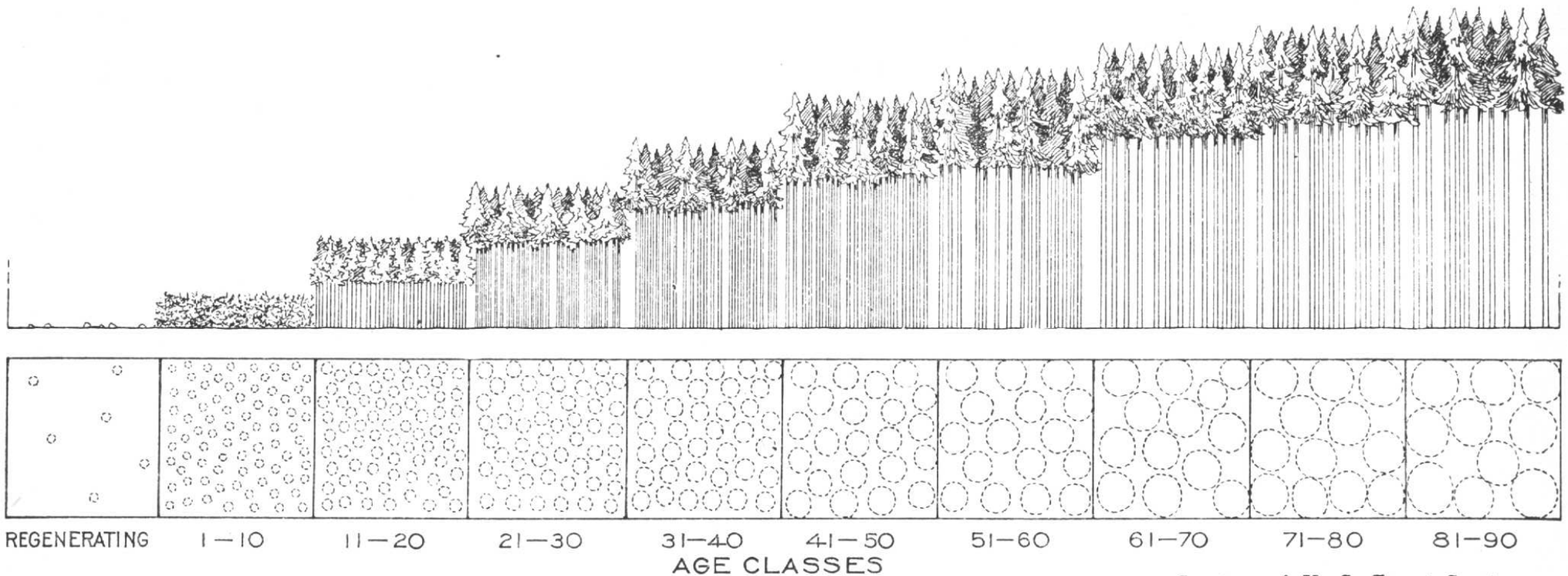
C. The Normal Forest

The normal forest is the completely regulated forest, that is, ideal for management. It requires the presence of:

1. *A normal increment,* by which is understood the best obtainable growth for a given species, site, rotation, and system of management.

2. *A normal distribution of age-classes,* which exists when a forest is made up of a series of forest stands of equal productivity varying in age by equal intervals from the youngest age to the full rotation age.

3. *A normal growing stock.* This is present in a forest if and when the two previous requirements are met. The growing stock is usually expressed in volume, that is, so many cubic feet or board feet of wood per acre, per stand, or other forest unit. It can also be expressed in value. In European forests the growing stock actually present in the forest usually approaches the normal growing stock rather closely, but in the United States the actual growing stock is often not more than 30 per cent of what it should be and may be considerably less.



Courtesy of U. S. Forest Service

Fig. 29. A Forest with a Series of Even-aged Stands.

D. Sustained Yield

A basic objective in forest management is to so regulate the growing stock that it contains at all times a proper proportion of young, middle-aged, and mature growth, and in this way is capable of producing wood continuously, that is, provide a sustained yield. This principle stands in strong contrast to the cut-out and get-out habit of the lumberman of the past. Sustained yield is the prime essential of good forest management. It is not limited to timber but applies to all kinds of forest products.

E. Forest Surveys

To develop effective plans for forest management on a sustained yield basis it is necessary to possess adequate information about forest conditions. This is not available at present in most parts of our country. To supply this information a number of extensive forest surveys are now in progress. In 1930 initial plans were made and field work was started on a nation-wide forest survey. The U. S. Forest Service is now going forward with comprehensive surveys in the Pacific Northwest, the Southern States, the Lake States, the Southern Appalachians, and several other forest regions. Preliminary plans have been made for an extension of these surveys to other forest regions. In some states considerable progress has been made in recent years in building up reliable forest growing stock inventories, and growth and yield data. In making a forest survey it is important to gather information on site, growing stock, growth, reproduction, protection, taxation, insurance, finance, and other important subjects.

F. Management Plans

Management plans concern themselves chiefly with the development and disposition of the timber and other forest crops. Their general purpose is to bring together in one or several documents the guiding principles and measures that are deemed necessary for the control and development of the business of forest crop production and yield within a specific forest area. An 84-page bulletin on management plans with special reference to the National Forests was prepared by the U. S. Forest Service. Other common forest plans are working plans (annual and periodic), development plans, acquisition plans, recreation plans, and cutting plans. Development plans give special consideration to roads, trails, bridges, dams, telephone lines, boundaries, fences, water systems, and buildings.

Master plans, covering all phases of forestry work, are now being prepared for many national forests. These plans aim to develop an effective integration of forestry activities.

IV. RECREATION MANAGEMENT

Recreation is now generally recognized as a major activity in all broad-gauge public forestry programs. On many forest areas it ranks first in importance, exceeding all other forest values. It is significant, however, that forest recreation is an activity that does not take care of itself. It requires careful direction and continuous supervision. It calls for definite management plans.

The Chief Forester of the United States in a recent report said:

"In a Nation faced with an increase in the leisure time available to its citizens, and with need for providing means of escape from the intensity of urban life and employment in monotonously repetitive occupations, failure fully to realize the recreational potentialities of the national forests would be a social error. In regions where other economic activities rapidly are dwindling, failure to develop those recreational uses would be an economic injustice to the scores of dependent communities. These circumstances create an obligation to recognize recreational use as a major purpose and service of the national forests and to provide suitably for its development."

Many states have already made considerable progress in the development of recreational opportunities and facilities within their forests. Laws have been enacted authorizing proper state officials "to set aside within state forests unusual or historical groves of trees or natural features especially worthy of permanent preservation, to make the same accessible and convenient for public use, and to dedicate them in perpetuity to the people of the commonwealth for their recreation and enjoyment." Counties, towns, cities, communities are also making considerable progress in providing recreational opportunities and facilities in nearby parks and forest areas.

A. Types of Forest Recreation Areas

Among the forest recreation areas that are now being developed are:

1. Superlative areas (Parks and monuments)
2. Primeval areas
3. Wilderness areas
4. Roadside areas
5. Camp grounds and campsite areas
6. Residence areas
7. Outing areas

In the states, forest recreation areas are designated as state forest parks, state forest monuments, state forest camps, state forest camp sites, scenic drives, scenic views, ski trails, bobsled runs, canoe routes, and mountain trails.

B. Principal Types of Recreational Use of Forests

1. Camping
2. Hiking
3. Hunting
4. Fishing
5. Picnicking
6. Motor touring
7. Boating
8. Swimming
9. Pack train trips
10. Winter sports

Each of these general groups is susceptible to a considerable "break down," for example, winter sports includes skating, ice boating, tobogganing, dog sledging, snowshoeing, and skiing.

Not all recreational uses of the forest are equally worthy of encouragement. Priorities among recreational uses should be carefully considered.

C. Use of National Forests for Recreation

During 1937 more than thirty million visitors used the national forests for camping, picnicking, fishing and other forms of recreations. The U. S. Forest Service now maintains 6,000 free public camp grounds for the use of vacationists, and other facilities are furnished by more than a thousand hotels, resorts, clubhouses and similar structures within national forest boundaries. Hundreds of resorts and dude ranches adjacent to the forests, accomodate many guests each year.

The visitors to the national forests during 1937 by classes were as follows:

Special Use Permittees and Guests	857,359
Hotel and Resort Guests	2,165,329
Campers	2,836,040
Picnickers	5,973,930
Motorists, horsemen, hikers, etc. to enjoy scenery	18,969,280
TOTAL	30,801,938

Thirty-three of the 157 national forests had more than 100,000 visitors each. The Angeles National Forest in California with 1,481,000 visitors had the largest total number of visitors of any national forest.

D. Use of State Forests for Recreation

State forests are being used for a wide range of recreational purposes. The main use of many state forests especially in the northeastern states is recreation. The foremost use of the forest preserves of New York State is recreation, and an increasing emphasis is being placed on forest recreation in New Hampshire, Connecticut, Pennsylvania and many other states. Beginning with 1914 campsites have been leased on the state forests of Pennsylvania. The number of sites leased annually is in excess of 3,000 and the annual income in excess of $30,000.

E. Rapid Increase in Forest Recreation

The number of visitors that used the national forests in 1937 was 29 per cent greater than in 1936 and one thousand per cent greater than in 1916. Not only on the national forests, but also on

the state, county, municipal and private forests has there been an enormous increase of recreational use. This increased use is in part explained by recreational facilities that have been provided and the many miles of roads and trails that have been built to new recreational areas. For example, in 1929 the New York Conservation Department operated fifteen public camp grounds used by 129,883 persons, and only seven years later in 1936 the number of camp grounds was twenty-eight and the number of persons using them was increased to 572,831.

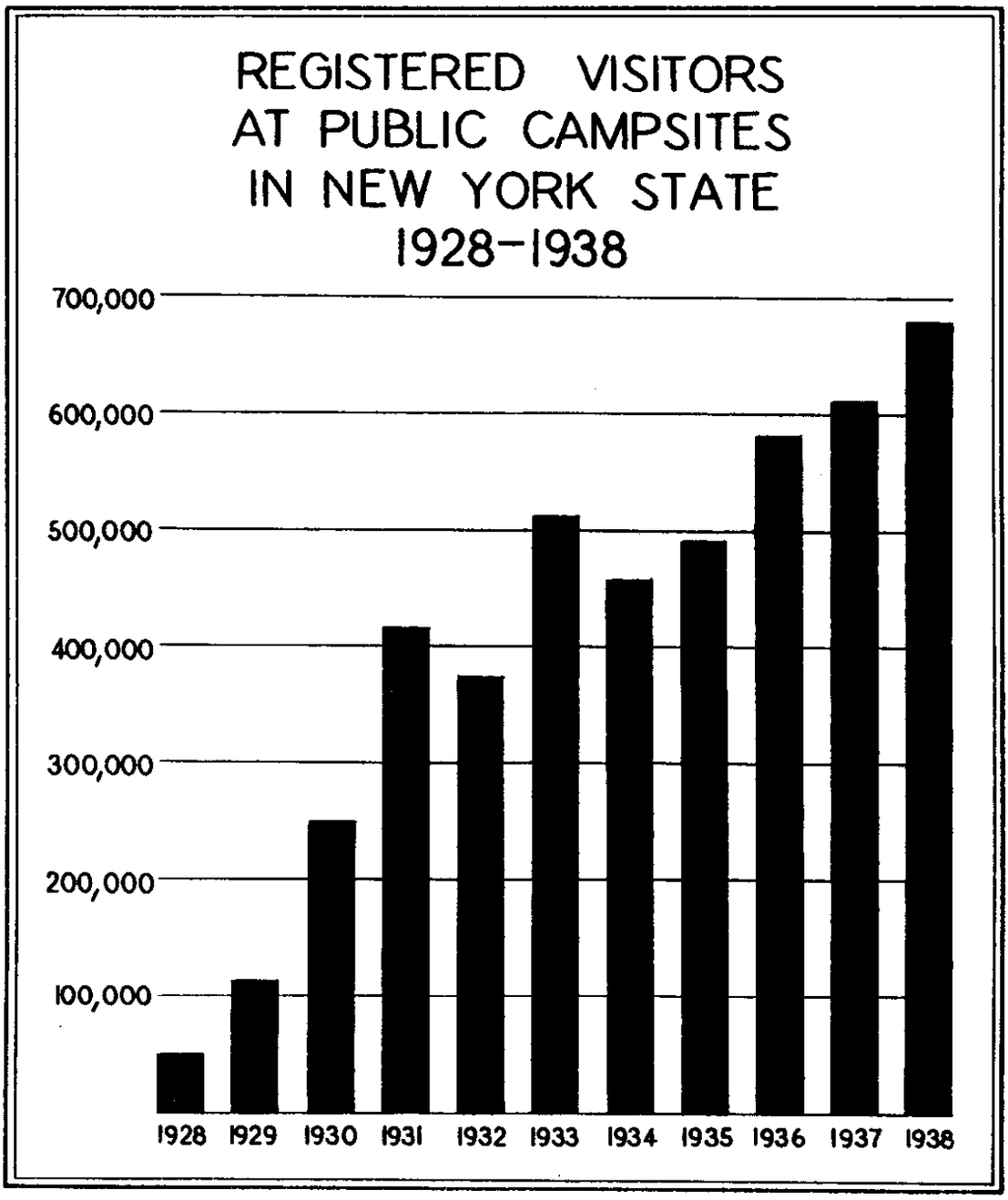


Fig. 30. Registered Visitors at Public Campsites in New York State (1928-1938).

F. New Administrative Agencies for Forest Recreation

New administrative agencies are springing up rapidly to handle forest recreation. In the U. S. Forest Service there now is a division of "Recreation and Lands." In the Conservation Department of

New York is a bureau of "Recreational Development." In 1935 the State Forestry Commission of New Hampshire was changed to the State Forestry and Recreation Commission, and in 1936 Wisconsin set up a Division of Recreational Publicity and Education in her Department of Conservation. These are only a few of the many administrative setups created in recent years to handle forest recreation activities.

G. Recreation—A Planned Forest Land Use

Until comparatively recently the recreational enjoyment of the forests of this country have been largely incidental. We now know that forest recreation has a definite value in our lives, and deserves to be considered in every plan of forest land use. In many cases the scenic and recreational values of specific forest areas are paramount, and therefore, deserve a dominant position in management plans.

QUESTIONS

1. What is forest management? Name five principal kinds of forest management. What is multiple purpose management?
2. Name five principal subjects in forest management.
3. Tell how the degree of forest management varies from forest to forest.
4. Describe briefly the basic motives and principles of forest management.
5. Outline the scope of forest management by listing some of its major activities.
6. Discuss land classification and land use, giving special consideration to great changes and possible future programs.
7. Discuss the importance of soil conservation.
8. What is meant by timber management? growing stock? rotation? normal forest? sustained yield?
9. Why is it necessary to make forest surveys? to develop forest management plans?
10. Discuss the growing importance of forest recreation.
11. Name the principal types of forest recreation areas.
12. What are the principal recreational uses of forests?
13. Discuss the increased recreational use of national and state forests.
14. What new administrative agencies have been springing up in recent years to handle forest recreation activities?
15. Why should forest recreation be included in land use programs?

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CHAPTER XVIII

RANGE AND WILDLIFE MANAGEMENT

I. RANGE MANAGEMENT

The term "range" is usually associated with grazing or stock raising in the West. Vast areas of grazing lands are located in the western states, where an enormous cattle, horse and sheep business has been developed on both public and private lands. In addition to the extensive grazing lands of the West there are also large grazing areas in other parts of the United States. It is estimated that nearly 150 million acres of forest land are grazed in the South, and that approximately thirty-six million acres of forest land, chiefly farm woodlands, are grazed in the Central, Lake, Middle Atlantic and New England States.

A. Forage—A Major Forest Resource

Forage is a major forest resource. It plays an important role in the production of our nation's meat and wool supply, furnishes employment to a large number of stockmen, and provides means for maintaining many farms and homes that would otherwise be abandoned. Chief Forester Silcox of the U. S. Forest Service in an address said:

"Forage is a major resource of the national forests. It provides, in the West alone, feed for some 75 per cent of the West's big game. It also furnishes sustenance for more than 1,400,000 cattle and 6,000,000 sheep owned by some 26,000 individual persons. And those people, their ranches, and the communities they support are (through livestock) just as dependent upon this forage as is big game. So that national forest forage materially and directly contributes, through domestic stock and big game, to the permanence and stability of our social and economic structure."

B. Kinds of Forest Forage

Forest forage is produced by a great variety of herbaceous and shrubby plants growing in natural openings between forest stands and as undergrowth beneath forest trees. It varies widely from region to region and from site to site. The same plants do not grow on all range areas. On some areas, coarse shrubs and grasses prevail while on others relatively tender shrubs, weeds and grasses are most common. The U. S. Forest Service recognizes ten types

of forage on national forest ranges. Among them are grassland range, weed range, sagebrush range, browse range, woodland range, aspen range, waste range in dense timber or brush, and barren (no forage) range.

C. Ownership of Range Lands

Most of the grazing lands of the United States are in private ownership. These lands are grazed by the stock of the landowners or they may be leased to stockmen. There are also millions of acres of publicly owned range lands within national forests, the public domain, Indian reservations, and state forests.

D. Condition of Forest Range Lands

Most of the range lands of the West were once open to grazing without regulation. Cattlemen could then graze their stock without any restrictions. As a result the ranges were rapidly exploited and their condition deteriorated to the extent that many of them became almost barren wastes. In this deteriorated condition they were practically useless for grazing purposes. As a result there was dissatisfaction and strife everywhere among the stockmen. Something had to be done to bring about a practical solution and orderly settlement. After prolonged discussion there emerged out of this distressing situation the beginning of range management which may be defined as the best sustained use of forage resources on range lands.

E. Range Management Principles and Practices

Experience and experimentation have demonstrated that the successful management of forest range resources requires the application of the following principles and practices:

1. The restoration and maintenance of a satisfactory growth of good forage plants.
2. The determination of the proper class of stock to which specific ranges are best suited.
3. The determination of the proper seasonal use of ranges.
4. The regulation of the number of stock grazed on specific areas.
5. The proper distribution of grazing stock so as to reduce damage around natural congregating places, to insure equal utilization of grazing areas and to provide necessary protection to specific areas in need of it.
6. The development of necessary range improvements.
7. The adaptation of range management methods to local conditions.
8. The proper coordination of range management with other forest uses and practices, including timber management, watershed protection, wildlife management and recreational uses of the forest.

F. Range Improvements

At the time range management was started most of the forest ranges were undeveloped. A wide range of improvements were needed to put them in condition for effective management. Among these improvements are:

1. Fences—boundary, division and enclosure.
2. Water Development—holes, dams, reservoirs, wells, springs, tanks and troughs.
3. Salting Equipment—logs, troughs, and boxes.
4. Control of Poisonous Plants. Heavy livestock loss results each year from poisonous plants such as larkspur, loco, death camas, and water hemlock. In 1937, 5,066 horses and cattle and 24,688 sheep and goats, valued at approximately $350,000 were lost on the national forests from poisonous plants.
5. Control of Rodents and Predatory Animals. Rodents, such as prairie dogs, pocket gophers, jack rabbits and ground squirrels are responsible for a large amount of range damage. In 1937, 1,079 head of cattle and horses and 78,502 sheep and goats, valued at more than $500,000 were destroyed on the national forests by predatory animals.

G. Range Administration

The administration of the range resources on the national forests is handled by the Division of Range Management in the main office at Washington. In the regional offices of the U. S. Forest Service range management is set up as a separate administrative unit or combined with wildlife management. In 1934, the Taylor Grazing Act was passed. It aims to bring about an effective management of range resources on approximately 142,000,000 acres of public domain lands. To carry out the provisions of this act a Division of Grazing was set up and is now operating in the federal Department of Interior. Some of the western states have also organized special administrative units in their governmental setups to handle grazing.

H. Grazing on National Forests

During 1937, 19,497 grazing permits were issued for cattle, horses and swine on the national forests, and 5,652 permits for sheep and goats. The number of stock grazed under permits on the national forests during 1937 was:

Kind of Stock	*Total Number Grazed*	*Leading States*
Sheep	5,477,351	Idaho, Col., Utah
Cattle	1,254,425	Col., Ariz., Calif.
Horses	29,499	Mont., Idaho, Calif.
Goats	7,603	N. Mex., Ariz., Calif.
Swine	241	Calif., N. C., Ariz.

In addition to stock under permit, 41,204 cattle, 48,585 horses, 12,317 sheep, and 909 goats were grazed in the national forests during 1936 under free grazing regulations which authorize prospectors, campers, and travelers free grazing of not to exceed ten head of stock for domestic purposes. If the 5,000,000 or more young, (which are not counted or charged for) are added, the total number of domestic animals which graze annually on the national forests is approximately 12,350,000.

I. National Forest Grazing Fees and Receipts

On May 27, 1933 the Secretary of Agriculture approved a plan which will serve as a basis for grazing fees on the national forest. This plan provides "That the average national forest grazing fee of 14.5 cents per head per month for cattle and 4.5 cents per head per month for sheep in effect during 1931 be used as the basis fees, subject to adjustments each year in accord with fluctuations in livestock prices." The per head per month grazing fees for 1937 were 12.55 cents for cattle and 3.66 cents for sheep. The total receipts for the use of forage on the national forests for 1937 were $1,580,345.07—an increase of almost $140,000 over those of 1936.

J. Trends in National Forest Range Use

The trend in range use on western national forests is definitely downward. During the ten-year period from 1926 to 1936 the animal-months of grazing of cattle and horses decreased 18 per cent and of sheep and goats 17 per cent. It is predicted that there will be a considerable further reduction of grazing on national forests. This is not due to lack of demand, but because studies and surveys show that such reductions are necessary to insure a sustained yield of forage. Gradually the number of cattle, horses, and sheep grazed on the national forests is being adjusted to the proper range carrying capacity.

K. More Range Research Needed

Considerable range research is now carried on in the western national forests. The preliminary results of range studies now under way are already giving a better direction to the whole range management program. Much more research is needed in practically every phase of range management before a sound and enduring program can be worked out. Several federal agencies and a considerable number of universities, colleges, and experiment stations have started research projects in range management.

L. New Range Conservation Program

Early in September 1936 the western division of the Agricultural Adjustment Administration offered a range conservation program to

western livestock producers under the authority of the Soil Conservation and Domestic Allotment Act of 1936. The U. S. Forest Service and other federal agencies are cooperating by examining range units, establishing grazing capacities, and recommending improved practices. This program should result in substantial improvements in forest range conditions and practices.

II. WILDLIFE MANAGEMENT

A. Meaning of Wildlife and Wildlife Management

Wildlife is a new term. It is just emerging into general and professional use. Only recent editions of dictionaries define it. Its meaning and scope are not yet clearly fixed. The general public usually thinks of wildlife as *ferae naturae*—a thing of wild nature. In recent years, however, it has been developing a rather specific meaning. Now it usually refers only to untamed or undomesticated animals. The forest zoologist and the wildlife specialist think of it in rather technical terms. Under "wildlife" they include all wild vertebrate animals plus their associated environments. The forester and the wildlife manager have a somewhat different point of view. They think of wildlife as a renewable natural resource or as a crop to be harvested regularly. In common with other crops, it is a product of land and water and their associated environments.

Wildlife management is also a new term. It is just beginning to find a place in conservation setups, and starting to function in an effective way in conservation programs. Only in recent years was wildlife management given a definite place in the U. S. Biological Survey and not until 1936 was a Division of Wildlife Management set up in the U. S. Forest Service.

The broader term wildlife management is gradually replacing the commonly used term game management. Wildlife management may be defined as the art of producing sustained annual crops of wild vertebrate animals in suitable environments for a wide range of human uses and services. It aims not only to control (increase and decrease, if necessary) the yield of wildlife, but also to improve the quality above that produced by unguided nature. Game management is usually defined as the art of making land produce sustained animal crops of wild game for recreational use. It has a much more restricted meaning than wildlife management.

B. The Forest and Wildlife

Practically all essential requirements of wildlife occur in the forest. The forest serves as a full-time home or a part-time abode for many species of wild animals. Most big game animals, such as the moose, elk and deer, live regularly in the forest. They require

large forest areas, and are at their best in the depth of the forest. Other species make only a part-time use of the forest, remaining there during rest periods and breeding seasons, and fleeing there for protection. They find the most favorable conditions for their development on the mantel of the forest, that is, where the forest joins with fields, swamps and wastelands.

There is a close, often inseparable relationship between the forest and wildlife. This situation recommends a close coordination between timber management and wildlife management. They function at their best not when considered as separate activities, but when developed as essential parts of a broad and effectively integrated plan of management.

C. Principal Kinds of Wildlife Values

Wildlife has contributed continuously to man's need and pleasures since pioneer days. Early American history teems with reports on the importance of wildlife as a source of food supply, as a source of clothing and as a commodity of commerce. In recent years recreational, social, esthetic and other values of wildlife have come to the forefront. Among the principal values of wildlife now generally recognized are:

1. *Commercial or Economic Value.* The U. S. Biological Survey estimates that the annual meat and fur value of wildlife in the United States at more than $190,000,000. A report of the Pennsylvania Game Commission states that the 1937 game kill in Pennsylvania weighed approximately 8,538,000 pounds. By placing a value of only twenty-five cents a pound on this one-year game kill in Pennsylvania there results a total value in excess of $2,000,000. No complete estimates of the commercial and economic value of wildlife in the United States are available, but that it amounts to many millions of dollars is generally accepted.

2. *Recreational and Other Social Values.* Some of the most important values of wildlife cannot be expressed in dollars and cents. Outdoor recreation, including hunting, fishing and other forms of sport, are provided by wildlife in a rapidly increasing measure. Most Americans by nature, background, environment, or training are sportsmen. In this age of lengthening leisure, wildlife, if properly managed, can provide healthful recreation for a rapidly increasing number of people.

3. *Esthetic Values.* There is a distinctive beauty and inspirational stimulus in wildlife in its natural environment. Artists paint pictures of wildlife and designers of beautiful things weave the beauty of wild animals and birds in their patterns. Something moves us deeply when we see a graceful, antlered buck or other wild

animal standing among green trees. These values cannot be estimated in money or goods. They are intangible. But no one questions their existence or their inestimable value.

4. *Biological Values.* Wildlife also renders many services to man, such as assisting in the control of insect pests, the control of destructive rodents, the suppression of diseases, and the improvement of sanitation. These are usually called biological values. Some of these services could be performed by man, but often only at a great cost, and for other services man is entirely dependent on wildlife.

5. *Scientific Values.* Wildlife is of particular value to zoologists, ecologists, pathologists, and other investigators, especially in the field of medicine. The study of many species of wildlife have made possible contributions of inestimable value to mankind.

D. Principal Classes of Wildlife

Several methods of classifying wildlife are in general use. If classified on the basis of range requirements the following four classes (excluding fishes) are recognized:

1. *Farm Wildlife.* This includes species of wildlife, which, because of their short cruising radius and high requirements for cultivated land, are especially adapted to agricultural areas. The cottontail rabbit, bobwhite, quail, European partridge, fox squirrels, some furbearers, and many non-game birds belong in this class. These species occur on farm lands not by accident but because they are to a large degree dependent upon conditions provided only in connection with farming.

2. *Forest and Range Wildlife.* This includes species of wildlife that thrive best in a forest and range environment. Their cruising radius is greater than that of farm wildlife and their tolerance for agriculture less. Many of them accept and some of them even thrive under a low degree of crop cultivation. Deer, ruffed grouse and wild turkey thrive best on forest land interspersed with cultivated land. Pinnated and sharptail grouse thrive best on prairie or brush land with a limited interspersion of cultivated land. Sage grouse, antelope and western deer tolerate moderate grazing and forestry activities. Gray squirrels also belong in this class; also a number of valuable fur bearers and many non-game species. None of the species belonging to this class are adapted primarily to farm lands, but none require the exclusion of farming, grazing or forestry.

3. *Wilderness Wildlife.* This includes species of wildlife harmful to or harmed by economic land use, and therefore suitable only for management in reservations or wilderness areas. Elk and buffalo belong to this class because they damage farm crop and compete with livestock; grizzly bear, moose, caribou and mountain

sheep because they fail to thrive in contact with settlement; and mountain goat because they require an extremely rough and remote wilderness area. Some of the most valuable fur bearers and a number of rare non-game species also belong to this class. The species belonging to this class have a greater cruising radius than those belonging to Class 1 and 2.

4. *Migratory Wildlife.* This includes species of wildlife having such a long cruising radius that they always leave the land on which they were raised. The waterfowl and shore birds, the migratory doves and pigeons and the majority of non-game birds belong to this class.

Sometimes wildlife is also grouped into the following major classes:

1. *Big Wildlife*—deer, moose, elk, bear, antelope, mountain sheep and mountain goat.
2. *Small Wildlife*—squirrels, rabbits, oppossum and raccoon.
3. *Fur Bearers*—beaver, muskrat, mink, weasel, fox, skunk, and marten.
4. *Game Birds*—quail, grouse, pheasant, and wild turkey.
5. *Migratory Fowls*—wild geese, wild duck, and woodcock.
6. *Fishes*—fresh water fish, also called game fish.

E. Essentials for Wildlife Production

For the production of wildlife the following essentials are required:

1. Food.
2. Water.
3. Coverts.

These three essential materials must be present for all species, both sexes, all age-classes, and all activities at all seasons. In addition there must be a proper arrangement and distribution of these essential materials. All of the essential requirements of a species must be so distributed in space that they occur on an area that does not exceed the species' cruising radius. This is sometimes called *juxtaposition* of essential materials. Food, water and cover requirements must also be distributed over the entire species' range so that it is possible for each unit of the range, as determined by the species' saturation point, to produce its share of the total maximum population. This requirement is sometimes called proper *interspersion* of essential materials.

F. Factors and Influences of Wildlife Production

A wide range of factors and influences affect wildlife production. Among them are:

1. *Decimating Factors.* Among the decimating factors, which kill wildlife directly are hunting, predators, starvation, diseases, parasites, and accidents.

2. *Welfare Factors.* Among the factors of wildlife production that reduce productivity indirectly by decreasing the rate of breeding and reducing the defense against decimating factors are food supply, water supply, coverts and such special factors as gravel supply in case of many birds, salt supply for herbivorous animals, and necessary hibernating places.

3. *Environmental Influences.* Certain environmental influences affect wildlife. Among these are drainage, cultivation, forest cutting, and clearings, grazing, weather, and fire. These influences are sometimes favorable and sometimes unfavorable.

G. Wildlife Conservation Measures

Among the important measures used in the conservation of wildlife are:

1. *Restrictive Laws.* An innumerable number of laws have been enacted restricting and regulating the taking and kill of wild animals. Among the devices and measures set up for this purpose are closed seasons, reduced bag limits, removal of certain species from game lists, regulation of methods of taking wildlife, and limiting the taking of wildlife to specific days and hours.

2. *Predator Control.* Predator (Vermin) control as a means of conserving wildlife has been and is still in extensive use throughout the United States. This method of control has resulted in the widespread destruction of occasionally or supposedly harmful species of animals. Later studies showed that many of these measures are actually destructive rather than constructive in nature. Among the animals that were classified as predators are:

   a. Raptorial birds—hawks, owls and eagles.
   b. Fish-eating birds—herons, pelicans, and kingfishers.
   c. Carnivorous animals—bears, wolves, and coyotes.
   d. Fur-bearing animals—foxes, weasels, minks and skunks.
   e. Other animals, such as woodchucks, squirrels, and porcupines.

3. *Refuge Establishment.* Wildlife refuges, also called preserves, reserves, and sanctuaries have been used rather extensively to help replenish the supply of wildlife. Within these areas wildlife can live unmolested and unaffected by man. Experience has shown

that refuges are most effective with species that have a long cruising radius and of relatively little value to species with a short cruising radius.

4. *Artificial Replenishment.* This method of wildlife restoration is in extensive use throughout the United States. Game farms, wildlife rearing establishments, and wildlife propagation stations are operated in most states. Artificial replenishment includes both restocking with foreign species and the release of native species produced under artificial conditions. On the whole the restocking with foreign species has not been satisfactory, excepting a few species, and the artificial propagation of native species is very expensive.

5. *Wildlife Management.* This is the latest and most practical plan of handling wildlife. It is a naturalistic approach to the problem, and concerns itself almost wholly with the development of effective measures through providing productive environments.

H. Administrative Agencies for Wildlife Conservation

A large number of different agencies are concerned with wildlife conservation. In our federal government, matters of wildlife conservation are handled chiefly by the Biological Survey, the Forest Service and the Soil Conservation Service in the Department of Agriculture, the Bureau of Fisheries in the Department of Commerce, and the National Park Service and the Office of Education in the Department of Interior. Violation of federal wildlife conservation laws are handled by the Department of Justice. Under date of April 20, 1938, the National Emergency Council announced in the U. S. Government Manual that the Bureau of Biological Survey in the Department of Agriculture is the "wildlife service of the federal government."

Practically all of the states have administrative setups for the handling of wildlife. In about half of them wildlife matters are handled in Departments of Conservation, in which separate divisions of fish and game are set up. Some states have Departments of Fish and Game. Others have Game Commissions and Fish Commissions, and still others have special administrative divisions for law enforcement, shell fisheries, commercial fisheries, fur animals, and game refuges.

I. General Organizations for Wildlife Conservation

Many different national, state and local organizations are giving their attention to wildlife conservation. Among the national organizations are the American Nature Association, the American Wildlife

Association, American Wildlife Institute, General Wildlife Federation, the Wildlife Society, Izack Walton League of America, and the National Association of Audubon Societies.

Within most of the states are state, country and other local organizations giving consideration to general and specific matters of wildlife conservation.

J. Cooperation

In recent years federal, state and other agencies have shown a tendency to cooperate closely in the management of wildlife so that there may be a united and effective effort to understand wildlife problems and improve wildlife conditions.

K. Wildlife Studies and Surveys

Effective wildlife programs and projects cannot be initiated and maintained without more studies and surveys. Too little is known now about wildlife and its effective management. All major agencies responsible for wildlife management are developing a wide range of studies and surveys. Among the studies of the Division of Wildlife Management of the U. S. Forest Service in 1937 were physical, chemical and biological surveys of thirty lakes on the Snoqualine National Forest in Washington, 130 on the Willamette National Forest in Oregon, and 1,003 bodies of water in the Lake States.

QUESTIONS

RANGE MANAGEMENT

1. What is meant by range management?
2. What is forage? Discuss the importance of forest forage.
3. What different types of forage are found on national forests?
4. Discuss the ownership of range lands.
5. Explain some of the important principles and practices essential to successful range management.
6. What improvements are required to put grazing ranges in condition for effective management.
7. How are federal grazing ranges administered?
8. Discuss the extent of grazing on national forests.
9. What fees are charged for grazing on national forests?
10. Compare the receipts from grazing and from timber cutting on national forests.
11. Explain recent trends in forest range use.
12. Discuss the new range conservation program.
13. Explain why more range research is needed.

WILDLIFE MANAGEMENT

14. What is meant by the term wildlife? by wildlife management?
15. Distinguish between wildlife management and game management.
16. Is wildlife a major forest resource? Explain.
17. What different values of wildlife are generally recognized?
18. Outline several methods of classifying wildlife.
19. Name three essential materials for wildlife production. What other essentials are required?
20. Discuss the principal factors and influences that affect wildlife production.
21. Discuss important conservation measures now in general use.
22. What animals are classified as predators?
23. Discuss the advantages of wildlife refuges.
24. What are the principal federal and state agencies engaged in wildlife administration?
25. What important public organizations are giving special attention to wildlife conservation?
26. Why is it necessary to have more studies and surveys of wildlife problems?

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CHAPTER XIX

BUILDING-UP FOREST IMPROVEMENTS AND EQUIPMENT

I. NEED FOR FOREST IMPROVEMENTS

Most of the forests of the United States are still in an unimproved and undeveloped condition. Practically all the forest land that has come into national, state, county, municipal, and other forms of public ownership had few, and in many cases not any, improvements upon it at the time it was acquired. Considerable progress has been made, particularly during the last 20 years, in the development of necessary improvements upon these forest properties. The first specific appropriation for improvement work on the national forests was made in 1909 in the amount of $600,000. Since then appropriations for improvements have been increased until in recent years the annual expenditures of the U. S. Forest Service for improvements and equipment has exceeded $20,000,000. Most of this improvement money has been applied to the development of roads, trails, and structures. In 1937, more than $12,600,000 was expended on the construction of truck and horse trails, and more than $11,300,000 on the construction of other structural improvements.

II. IMPORTANT FOREST IMPROVEMENTS

A. Forest Roads and Trails

The key to the successful handling of forest properties is an adequate and well-coordinated system of forest roads and trails. Some of the major services of forest roads and trails are:

1. They open up undeveloped forest regions.
2. They help provide adequate protection.
3. They serve as a carrier of persons and products out of, into and about the forest.
4. They serve as boundary and subdivision lines.
5. They are helpful to hunters, fishermen and other forest users.
6. They encourage forest study tours and make possible accurate forest surveys and special forest studies.

Forest roads are usually low cost earth roads. In recent years the average cost of primary forest roads in Pennsylvania was $805 a mile and on the national forests in California $1,132 a mile. On the Payette National Forest in Idaho, the construction cost of primary forest roads was $2,500. Maintenance costs for forest roads throughout the United States averaged $100 a mile a year for primary and $20 a mile for secondary roads.

Good forestry requires not less than one mile of road for every 250 acres of forest land. Under intensive forest management one mile of road is needed for 100 acres. On some state forests in this country, there is now one mile of road for every 600 acres of land, and on the national forests one mile for every 3,000 acres. There are still areas of 50,000 acres within national and state forests without a single mile of serviceable forest road. In Germany there are many forests with one mile of road to every 50 to 100 acres of forest land.

A greatly enlarged forest road construction and maintenance program is now in operation throughout most of the publicly owned forests of the United States. The appropriation of the U. S. Forest Service for 1937 for truck and horse trail construction and maintenance was $16,000,000, and for forest highways, more than $8,000,000. Roads and trails work is among the major activities of the boys now in the Civilian Conservation Corps Camps located in all parts of the country. Up to June 30, 1937 the construction or improvement of 21,918 miles of forest highways, 80,568 miles of development roads and truck trails, and 138,496 miles of trails had been made possible on national forests from direct forest road appropriations and other federal and cooperative funds apportioned to states. More than $294,000,000 of federal funds has been expended on road and trail construction and maintenance in the history of the U. S. Forest Service. In addition to the work that has been done already there still remains an urgent need for more and better forest roads and trails, for the development of well located, carefully constructed, adequately drained, regularly maintained and well coordinated systems of roads and trails, which are among the most essential needs of effective forest management.

B. Forest Buildings

Many different kinds of buildings are needed in the handling of forest properties. Among the types of buildings used rather widely at present are:

1. Houses for forest officers.
2. Offices and general headquarters.
3. Barns, stables and garages.
4. Nursery packing and storage houses.

5. Sheds, pens and toolhouses.
6. Sawmills and other wood-using plants.
7. Cabins and camps.
8. Fire places, lean-tos, shelters, comfort stations, drinking fountains, inns and hotels.

C. Other Common Forest Improvements

1. Bridges, dams, pools, ponds, lakes, reservoirs and stream gauging stations.
2. Telephone and power lines.
3. Observation towers, lookout stations and guard stations.
4. Fire lanes, also called fire lines and fire breaks.
5. Boundary lines, fences and corrals.
6. Springs, wells, water holes and water systems.
7. Toilet, sewage and drainage systems.

III. IMPORTANT FOREST EQUIPMENT, MATERIAL AND SUPPLIES

Forestry by its very nature requires large quantities of equipment, material, and supplies. Among the 1937 expenditures of the U. S. Forest Service was an item of $5,348,658.90 for "equipment and stores." When work was started on the national and state forests, very little operating equipment was available for use. Year by year necessary equipment has been acquired and now most of it can be grouped under the following principal headings:

A. Transportation Equipment

Automobiles, trucks, motorcycles, tractors, graders, wagons, sleds, drags, scrapers, wheel barrows, boats, pack baskets, snow shoes, and airplanes. On August 25, 1938 the U. S. Forest Service came into possession of the first service-owned airplanes—a $15,000 Stinson Reliant Airplane. This 450 horsepower fire fighting and experiment plane will be used in the suppression of forest fires.

B. Forest Fire Equipment

Trucks, towers, water pumps, water tanks, buckets, fire hose, fire extinguishers, torches, tool boxes, saws, axes, shovels, rakes, brush hooks, flashlights, and lanterns.

C. Forest Insect Control Equipment

Insecticides, insectories, cages, torches, chemicals, pruning shears, pruning saws, spray tanks, trucks, and dusting apparatus.

D. Forest Fungi Control Equipment

Fungicides, ladders, spore traps, mixing tanks, spraying tanks, grubbing tools, pruning saws and shears, and trucks equipped with spraying apparatus.

E. Communication Equipment

Telephones, radios, and signals. In 1932 the U. S. Forest Service had less than a dozen radio sets. In January 1938 it had twenty-four hundred sets.

F. Camping Equipment

Cots, stoves, tents, blankets and kitchen utensils used in forest protection and road work, and by tree planting and survey crews.

G. Nursery and Tree Planting Equipment

Plows, harrows, cultivators, planting tools and planting machines.

H. Wood Cutting, Logging and Milling Equipment

Axes, saws, wedges, sledges, peavies, cant hooks, chains, sawmills, shingle mills, and lath mills.

I. Forest Mensuration Equipment

Calipers, tapes, tally boards, log scales, hypsometers, increment borers, tabulating and plotting forms, and blue printing material.

J. Surveying and Mapping Equipment

Transits, compasses, plane tables, levels, chains, pins, rods, targets, drafting boards, drafting tables, rules, pens, pencils, tracing cloth, drafting paper.

K. Forest Maps

Among the principal types of forest maps are national forest maps, state forest maps, and maps of forest regions, forest types, timber estimates, plantations, logging units, sub-division units, public use, recreation and property boundaries.

L. Forest Signs, Markers and Posters

Signs, markers and posters are used extensively in forestry. Widely used are direction signs, place signs, boundary markers, trail markers, educational posters, warnings, messages, and proclamations.

M. Photographic Equipment

Cameras, negatives, photographs, lantern slides, movie films.

N. Office Supplies

Furniture, file cases, typewriters, adding machines, mimeograph and multigraph machines, books, bulletins, pamphlets, paper, pens, pencils, forms, receipts, checks, envelopes, and postage stamps.

O. Miscellaneous Material

Lumber, paint, plumbing and electrical supplies, forges, general repair tools, cement, sand, seed, hay, moss, dynamite, and insect powder.

QUESTIONS

1. Are most of the forests of the United States still in need of improvements?
2. What are the principal services of forest roads and trails?
3. What kinds of roads are needed in a forest? How much does it cost per mile to construct and maintain serviceable forest roads?
4. Approximately what road mileage is needed per thousand acres of forest land for intensive forestry? for extensive forestry?
5. List the principal kinds of buildings used in forestry.
6. Name important forest improvements, other than roads, trails and buildings.
7. What are the principal groups of equipment used in forestry?
8. Discuss the principal kinds of transportation equipment used in forestry.
9. Discuss the different kinds of equipment used in forest mensuration.
10. To what extent is the radio used in forestry?
11. For what purposes are forest maps used?
12. Should the use of forest signs and posters be extended?
13. How important is it to keep forest improvements and equipment in a good condition?

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CHAPTER XX

THE UTILIZATION OF FOREST PRODUCTS

The conversion of standing timber and other forest products into forms and commodities usable by mankind is known as forest utilization. It includes the harvesting of forest crops, the transportation of forest products, the manufacture of these products into serviceable commodities, and the marketing and distribution of these products and such commodities as are developed from them.

I. LOGGING OPERATIONS

The series of forest operations beginning with the felling of the trees and extending to the delivery of the logs at the sawmill is known collectively as logging. The production of saw logs comprises by far the major part of logging operations, but it also includes the production of pulpwood, cross ties, poles, posts, mine timbers, veneer logs, and other miscellaneous forms of forest products. Recent estimates show that logging operations represent at least one-half of the total cost of putting lumber on the market.

A. Felling

Tree felling is done usually by crews of two men each. The fellers use either an axe or a saw, and often they use both. As a rule, the trees are undercut with an axe on one side and then sawed through from the other side. By proper undercutting the trees can be made to fall in definite directions. Skilled fellers can throw the trees so that a minimum of damage will be done to the trees themselves and to the young growth of the forest. In Europe a number of different types of tree felling machines are used rather widely by forest workers. They help protect the young growth and also reduce the amount of damage done to the felled trees.

B. Log Making (Bucking)

After the trees have been felled, the next operation is to cut the stem into proper log lengths. This is locally called *bucking*. In the East, two men with a cross-cut saw, an axe, a sledge and several wedges make up the bucking crew. On the Pacific Coast, the men generally work singly using a cross-cut saw with one handle removed. Numerous attempts have been made to develop mechanical

tree felling and log making devices driven by gas, compressed air or electricity, but no real substitute has been found for a good cross-cut and axe with plenty of "elbow grease."

While one crew is making logs another crew may be cutting the branches from the main stem and lopping the branches of the tree crown. This branch removal operation is called *limbing, swamping,* or *lopping.* Some states have rigid top lopping laws enacted as a forest fire prevention measure.

C. Skidding

After the logs are cut the next operation is to transport them to the sawmill or some special wood-working plant. The moving of the logs from the place they are made to the first collection place is known as *skidding.* In most cases the logs are dragged on the ground by horses, oxen, mules or tractors. Tractors and other mechanical equipment are rapidly replacing animal power. In skidding operations it is a common practice to raise the front end of logs on a low simple sled and in this way prevent the logs from nosing into the ground. High two-wheel and low two-wheel carts are also used in skidding, especially in the South.

In large logging operations steam power is used extensively for skidding. Donkey engines do many logging operations and are used extensively both in ground and aerial skidding. Rarely is a single means of log transportation used in a logging operation. As a rule, several, and sometimes as many as seven different means of transportation are used in getting logs from the woods to the mill. In some localities slides, chutes and flumes (if water is available) are used to supplement other means of log transportation.

D. Hauling

After the logs are assembled on skidways in the forest it is necessary to transport them to the mill. If the haul is short, wagons and sleds are frequently used. For longer distances, the hauling is usually done on railroads or by trucks. Hauling of logs for several hundred miles is not uncommon. Under certain conditions the logs may be transported by water. This can take place in one of three forms, namely, loose driving of logs, rafting, or fluming.

E. Logging Camps

Logging camps for a hundred or more men are a common feature of most large logging operations. In the early days of lumbering these camps were usually crude, uncomfortable, and unsanitary. Now many camps are provided with up-to-date equipment and rate as first class temporary living centers. Most of these camps are temporary in nature and are designed with special por-

table features. Some lumbering firms have complete camp trains on their logging railroads equipped with bunk cars, kitchen cars, dining cars, office cars and even stable cars for the horses.

F. Selective Logging

The traditional logging practice in the United States has been to cut-out and get-out without making any provisions for forest renewal. Everything was cut that would yield a profit, and what did not yield a profit was left in the woods. In recent years an earnest attempt has been made to replace this practice of excessive and careless forest exploitation with better logging practices. The method that has been developed is generally known as selective logging. At first its main object was to determine the limits of profitable logging but gradually attention was also given to the perpetuation of good tree growth, and now the emphasis is gradually shifting to the development of the best and most economical logging methods from the viewpoint of a sustained forest growth. Selective logging can be done in such a way that in 15 to 20 years after a cutting it is possible to come back on the same area and make another cutting. It makes possible not only the continuation of logging operations but also contributes to sustained land values and to a greater economic and social security of forest communities.

II. THE MANUFACTURE OF FOREST PRODUCTS

The manufacture of lumber begins with the delivery of logs at the sawmill. It includes the sawing of logs into boards, planks and other stock of specified dimensions, also the edging off of the bark, the trimming of uneven and defective ends, the grading of products into standard classes, and the piling of the different kinds of lumber in the yard. It may also include the seasoning of the lumber, including kiln-drying.

A. Sawmill Operations

In normal times approximately 26,000 or more sawmills are engaged in the production of lumber in this country. Most of these mills are relatively small, but most of the lumber is produced by a relatively few large mills. Practically all of the large modern mills are equipped with band saws, some of them single-cutting and others double-cutting saws. Most of the older and smaller mills and some of the new ones operate with circular saws. On the whole the band saws produce more uniform lumber, have a greater output, and result in less waste in the form of sawdust. In addition to the main saws, many mills are equipped with supplementary saws in the form of re-saws and gang saws.

In states such as Washington—the largest lumber producing state—big mills turn out more than 85 per cent of the total lumber

production. In other large lumber producing states such as Louisiana, Oregon, California, and Texas, the big mills produce more than 75 per cent of the total lumber output. On the other hand, in regions of limited and scattered timber supplies, such as New

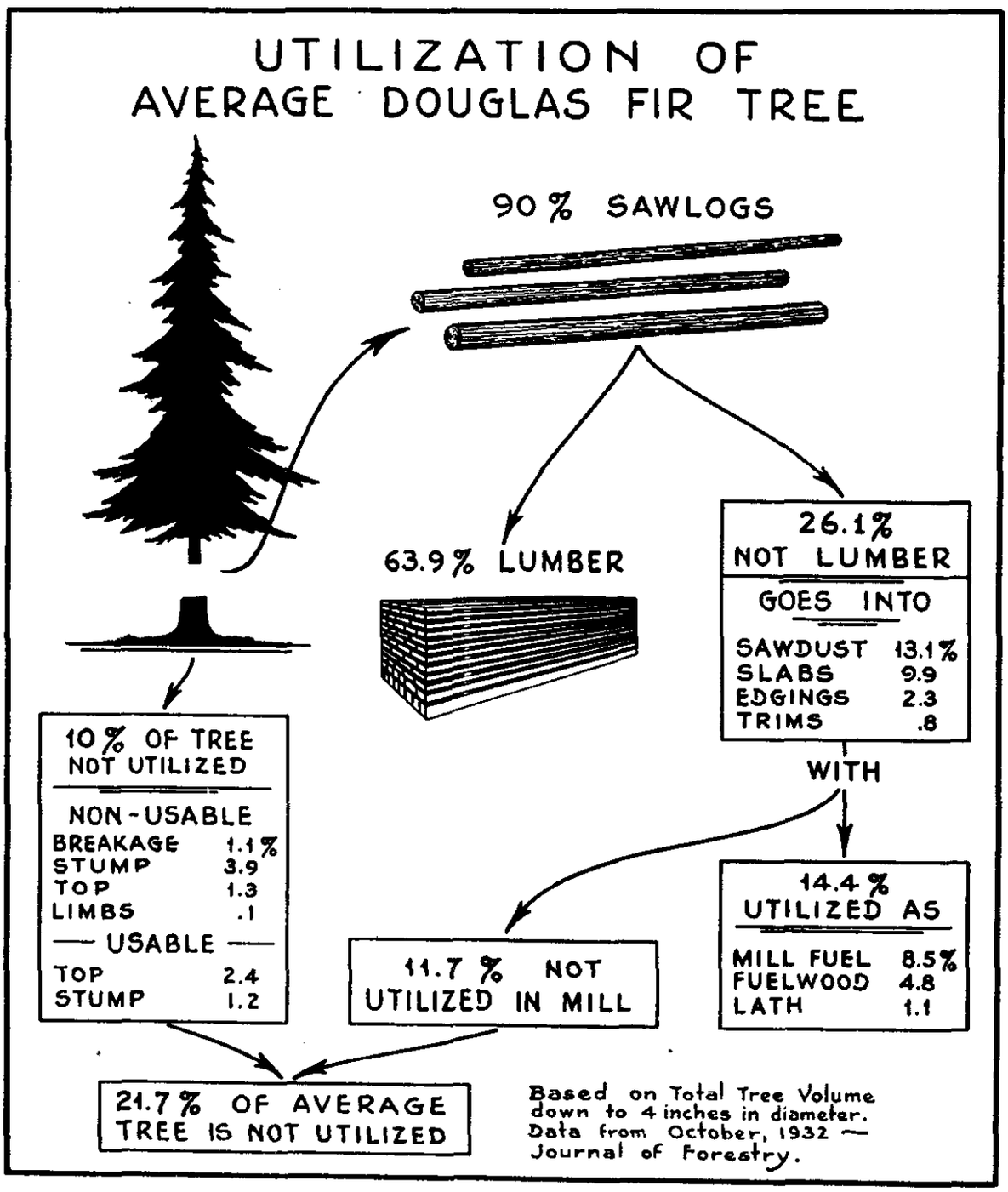

Fig. 31.

England, New York and Pennsylvania, more than 75 per cent of all lumber production comes from small mills, mainly of the portable variety. Many of the small portable sawmills have a daily capacity of 8,000 to 12,000 board feet per day, while a mill with two band saws and a re-saw can turn out 100,000 board feet

in an eight hour day. A few of the largest sawmills have developed an output of one million board feet in a 24-hour day.

B. Lumber Grading

After the lumber is sawed and while enroute to the lumber yard it is sorted and graded into a large number of grades in accordance with specific grading rules that have been developed through years of experience.

C. Lumber Piling

After the lumber has been graded it is usually piled by grades in the lumber yard. Approved piling methods have been developed that speed up air seasoning and prevent deterioration. The thickness of the lumber and climatic conditions are two important seasoning factors. In dry climates and high altitudes inch boards may dry out in several months while in low damp regions it may take a full year for satisfactory seasoning.

III. BETTER FOREST UTILIZATION

An enormous amount of waste occurs in logging, sawing and reworking timber into the final products used by man. It has been estimated that in some operations only 25 to 50 per cent of the total quantity of wood in standing trees is found in the ultimate products and commodities made from them. The waste begins at the very start of logging operations by cutting extra high stumps, careless felling and wasteful log-making and it continues right through the sawmill to the final product.

Wood has been so plentiful in this country that it became customary to use only the best and waste the rest. Until recently it has not been necessary to use wood economically, but with the rapid reduction of forest resources it has become necessary to develop less wasteful practices in the forest, in the sawmill and in the wood-using industries. For a long time wood was so cheap that it did not pay to conserve it, but now we know that the fine stands of original timber are becoming scarcer and scarcer and further away from the consuming centers. In recent years many studies have been undertaken to determine methods by which this enormous and unjustified wood waste could be greatly reduced. Much progress has already been made, and in the future a far greater per cent of the wood in the standing trees of the forest will find its way into the finished wood products used by man. A thorough understanding of our timber supplies and our timber requirements shows conclusively that a more economical utilization of forest products must be realized in the future. We cannot continue wasting our forest resources.

IV. MAJOR FOREST PRODUCTS

According to the federal census and other reports the average amount of wood used annually in this country from 1925 to 1929 was as follows:

Forest Products	*Total Amount Used Annually (Million Cubic Feet)*	*Per Cent of Total*
Lumber	7,371	50.8
Fuelwood	4,002	27.6
Hewed Ties	633	4.4
Fence Posts	629	4.3
Pulpwood	588	4.1
Mine Timber (round)	232	1.6
Veneer Logs	231	1.6
Cooperage (slack)	162	1.1
Logs and bolts in manufacture	156	1.1
Cooperage (tight)	141	1.0
Shingles	139	0.9
Miscellaneous (Poles, piling, export, logs, distillation and extract wood, excelsior, etc.)	211	1.5
	14,495	100.0

A. Lumber

Of the total lumber production in the United States (almost 25 billion board feet in 1937), as much as two-fifths goes direct from the sawmill and its attached planing mills into general construction and building materials, such as heavy timber, girders, beams, planking, studding, sheathing, roofing, fencing, etc. Large quantities of lumber are used in planing mills in the making of sash, doors, frames, baseboards, porch work, and flooring.

B. Principal Lumber Producing Trees

Of the total lumber production in the United States in 1933, about one-third or 4,400,000,000 board feet was supplied by yellow pine. More than one-half of the yellow pine was produced in the four states of Alabama, Louisiana, Mississippi and Texas. Douglas fir ranked next in order with a cut of 4 billion board feet, of which approximately 97 per cent was cut in the two states of Oregon and Washington. Other important species in the order of their importance were ponderosa pine, oak, white pine, hemlock, red gum, maple, spruce, and redwood.

C. Fuelwood

At one time fuelwood constituted the main product of the forest. Next to lumber, it is still the most important wood product of our forests, representing approximately 28 per cent of our total wood consumption. This is equivalent to about 60,000,000 cords.

Fuelwood is primarily a farm woodland product and is used chiefly on farms. The average farm family burns approximately seventeen cords a year. It is rarely hauled more than ten to twenty miles because of excessive transportation costs. The weight of a standard cord of green white oak is about 5,600 pounds and when air-dry about 4,250 pounds.

D. Ties, Poles, Piling and Mine Timber

Among the important woods used for these products are:

Cross Ties	*Poles*	*Piling*	*Mine Timbers*
Oak	Southern pine	Southern pine	Southern pine
Southern pine	Cedar	Douglas fir	Oak
Douglas fir	Douglas fir	Oak	Douglas fir
Ponderosa pine	Chestnut*	Chestnut*	Chestnut*
Lodgepole pine	Lodgepole pine	Ponderosa pine	Maple

V. SOME SPECIAL FOREST PRODUCTS

A. Naval Stores

As early as 1600, the collecting of the resinous sap of pine trees began in America. The sap was cooked into pitch, and used in the building and repairing of ships, whence the collective name "naval stores," which include pitch, rosin, tar, turpentine, and other pine products.

The naval stores industry is most active in the eight southern states extending from North Carolina to Texas. At present Georgia and Florida are the chief centers of production. In some of these states it is the leading industry. More than 60 per cent of the world's naval stores are now produced in the southern states. The active naval store belt comprises a land area of sixty-six million acres. The peak of the production of turpentine was reached in 1900, when 38,488,000 gallons were produced, and rosin reached its peak in 1908, when more than 4,000,000 barrels were marketed. Most of the naval stores products are derived from more than 100,000,000 slash and longleaf pine trees tapped annually, but limited quantities are also obtained from shortleaf, loblolly, and other southern pines. Until recently it was predicted that when virgin southern pine forests were cut out the naval stores industry would practically vanish, but now we know that by the adoption of improved practices applicable to the young fast-growing southern pine forests it is possible to maintain and even to advance the production of naval stores. Millions of trees have been planted in the naval stores belt in recent years. In 1936, more than six million slash pine seedlings were

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* Only limited quantities now available due to the destructive work of the chestnut blight.

planted in Florida alone. These planted trees are spaced approximately 12 x 12 feet apart, or about 300 trees per acre. It is estimated that in about fourteen years after planting they may be sufficiently large for tapping.

B. Maple Syrup and Sugar

Long before the white settlers came to this country the Indians made syrup and sugar from the sap of maple trees. Most of the sweet sap comes from the sugar maple tree. The sap is tapped from the trees by boring a hole a half inch in diameter and about two inches deep into the stem several feet above the ground and then placing a spile or spigot into the hole and collecting the dripping sap in a bucket. The tapping takes place early in spring, usually from late February to early April. The length of the season varies with weather conditions. The longest season on record was fifty-seven days and the shortest nine days. Extensive studies show that the sap flows most freely when the night temperature is about 25° F. and the maximum day temperature 55° F.

An average-sized maple tree may yield 20 gallons of sap in a season. Approximately 32 gallons of sap yield one gallon of syrup and 4 to 4½ gallons of sap are required to make a pound of sugar. The peak year of maple syrup production was in 1918 when 4,863,000 gallons were produced. In 1935, 12,496,000 trees were tapped by 30,000 farmers. They yielded 3,377,000 gallons of syrup and 1,704,000 pounds of sugar. Their total market value was approximately $7,000,000.

The leading states producing maple syrup and sugar are Vermont, New Hampshire, New York, Pennsylvania, Ohio and Michigan. In practically every county of Vermont the maple sugar industry is developed on a commercial scale.

C. Christmas Trees

About 20,000,000 Christmas trees are used annually in the United States. They are purchased at an approximate cost of $10,000,000. Most of the trees used for this purpose are cut from natural-grown forests. An increasing number, however, are being grown in plantations and as a result an attractive Christmas tree business is developing. Many farmers have found the harvesting of Christmas trees a profitable side line business. During some years New Hampshire exports as many as 800,000 Christmas trees (400 carloads.) The Christmas tree business gives employment to many people at a season of the year when they would be otherwise unemployed.

The legislature of Wisconsin has recently enacted a bill which places a tax of five cents per tree on all Christmas trees, whether cut in Wisconsin or shipped into the State, and a license fee of two dollars on all Christmas tree dealers. Minnesota also has a special Christmas tree law, providing for the licensing of dealers and the charging of fees.

D. Decorative Materials

At all seasons of the year enormous quantities of decorative materials are taken from the forest. Christmas holly, mistletoe, rhododendron, laurel, myrtle, azalea, ferns, and mosses are only a few of the many plants of the forest that are used for a wide range of decorative purposes.

E. Fruits and Seeds

Enormous quantities of forest tree seeds are used annually in nurseries for the production of seedlings and transplants. In some parts of the country acorns are an important factor in fattening hogs. The food value of chestnuts, beechnuts, pecans, and walnuts, is considerable. The Indians of California, Arizona, and the Northwest subsist to a considerable extent at certain seasons on the nuts of western pines. During an average year from 60,000 to 70,000 quarts of blueberries are marketed from a single tract of forest land in the Pocono mountains of northeastern Pennsylvania.

F. Cork

Cork is obtained from the outer bark of an evergreen oak (Quercus suber). The tree grows over a wide range, but the commercial production of cork is restricted to the countries bordering the western Mediterranean Sea. The richest and most productive cork forests occur in Portugal and Spain. The Iberian peninsula produces about two-thirds of the world's cork supply. Considerable quantities are also produced in France, Italy, Corsica, Sardinia. Morocco, Algiers and Tunis.

Cork-producing trees usually grow in open orchard-like stands. rarely more than thirty to sixty trees per acre. Practically all of the trees are grown in natural or wild stands. Only a few attempts have been made to develop cork oak trees in plantations. In 1858 a small number of cork oak were brought to this country and planted in the southeastern states.

It is estimated that 50 per cent of the total cork products of the world are now used in refrigeration. Considerable amounts are also used in the manufacture of gaskets, linoleum and about 5 per cent of the total production is used for bottle stoppers and other miscellaneous uses.

C. Rubber

Rubber is the product of a milky juice (latex) found in a variety of trees, shrubs, and vines of the Tropics. It usually occurs in the cortical tissue between the outer bark and the wood, but is also found in the leaves and roots of some tropical plants.

Rubber is one of the most important forest products used by mankind. The value of rubber imported in this country exceeds the combined value of all other imported forest products including lumber, pulpwood, tanning materials and dyewoods. Prior to 1900 wild rubber trees supplied practically all of the world's rubber supply. Now planted rubber trees supply more than 90 per cent of the total amount used. Prior to 1914 the principal source of Indian rubber was in the valley of the Amazon in Brazil, where the province of Para was the center of production. Fully 90 per cent of the world rubber supply is derived chiefly from the Para rubber tree—*Hevea braziliensis*, Müll. The rubber area in Brazil alone is estimated to cover more than a million square miles.

As early as 1873 attempts were made to grow rubber trees in plantations. At present 600,000 acres of rubber trees are in plantations in the Dutch East Indies, and 250,000 acres in Ceylon. Considerable rubber is also produced in Malaya, Sumatra, Java, and Burma (India). More than $60,000,000 of foreign capital is invested in these plantations.

QUESTIONS

1. What is forest utilization? What is logging?
2. Describe briefly and in proper sequence the principal logging operations from the felling of the trees to the delivery of logs at the sawmill.
3. Why are logging camps needed in lumbering operations? Describe a modern logging camp.
4. What is meant by selective logging? What are its principal objectives?
5. Compare small and large sawmill operations, with special reference as to location, operating methods used, kind and quality of output.
6. Why is it necessary to grade and pile lumber?
7. Why is it necessary to utilize forest products more economically? What is being done to use them more economically?
8. How much lumber is used annually in the United States? Compare the amount of lumber used with the amount of wood used for fuelwood, fence posts and mine timbers.
9. What are the principal lumber producing trees?
10. What is the naval stores industry? Name its principal products. How important is it?
11. In what part of the country is the maple syrup and sugar industry important?

12. How and where is the Christmas tree business progressing? What other decorative materials do forests supply? What states produce a large number of Christmas trees? Should there be a tax on Christmas trees?
13. Name some forest fruits and seeds that are important forest products.
14. Discuss the importance of cork and rubber among forest products.

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CHAPTER XXI

MEASURING AND MARKETING FOREST PRODUCTS

I. FOREST MENSURATION

Forest mensuration is one of the basic branches of forestry. It is both an art and a science. In part it concerns itself with the applied aspects of forestry. Other parts of it are highly technical in nature.

A. Definitions

1. Forest mensuration may be defined as the measurement of the content of logs, trees and standing timber, and the determination of growth and yield.—*Moon and Brown.*

2. Forest mensuration is the science which deals with the determination of the volume of stands, trees, and logs: and with the study of growth and yield of trees and stands.—*Belyea.*

3. Forest mensuration deals with the determination of the volume of timber products, logs, trees, and stands, and with the of growth and future yield of trees and forests.—*Mason.*

4. Forest mensuration deals with the determination of the volume of timber products, logs, trees, and stands, and with the study of the growth of trees and stands.—*Graves and Guise.*

5. The science of forest measurements, or mensuration as it is also called, is concerned with the determination of diameters, heights, or volumes either of standing timber or of products cut therefrom, such as saw logs or cordwood, and the determination or prediction of rates of growth.—*Bruce and Schumacher.*

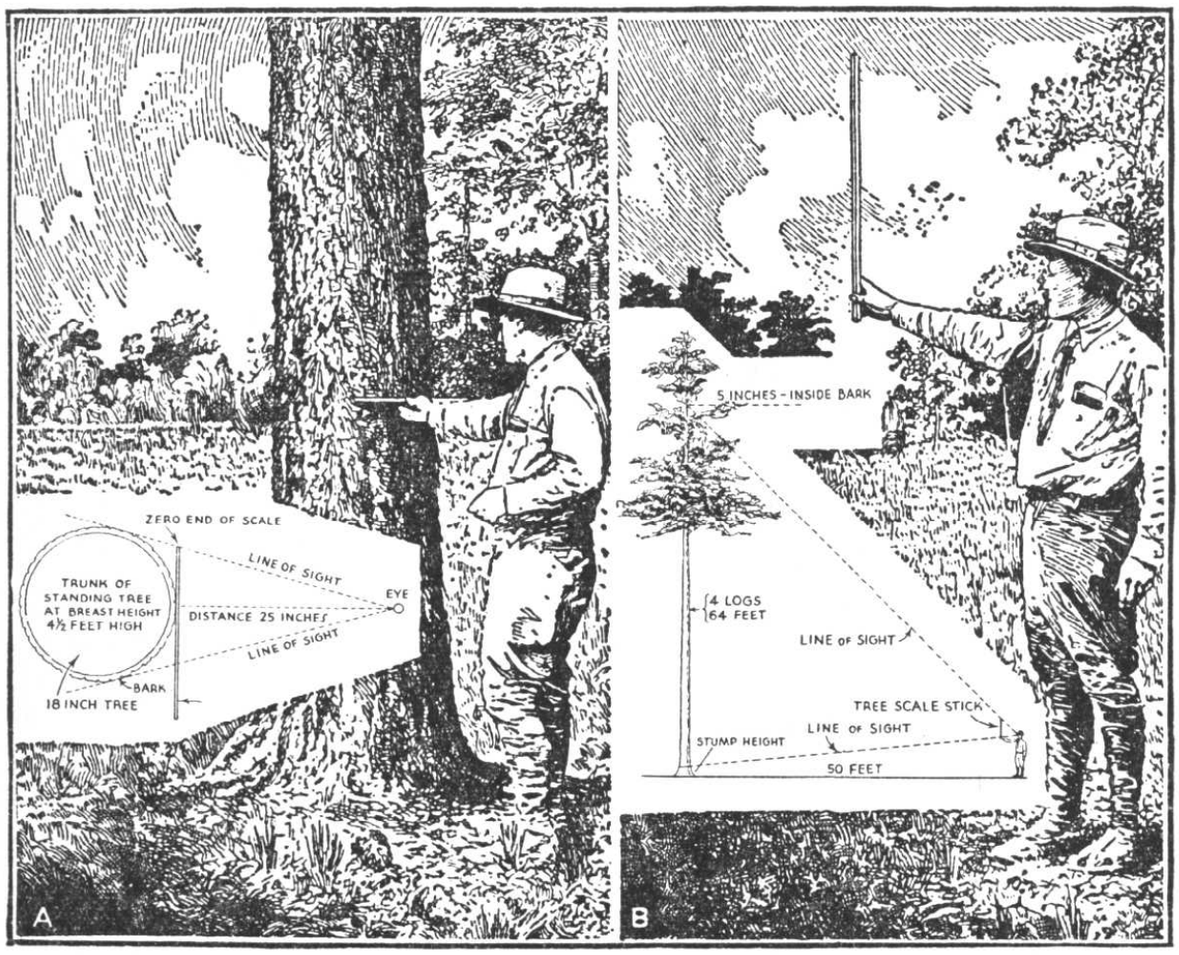
B. Divisions of Forest Mensuration

The subject material of forest mensuration can be divided into the four following divisions:

1. The measurement of standing timber.
2. The measurement of individual forest trees.
3. The measurements of logs, bolts, billets and other parts of trees.
4. The measurement of the growth and yield of forest trees and stands.

C. Units of Dimension

The principal units of dimension used in forest mensuration in the United States are diameter and length or height. Usually the diameter is expressed in inches and the length is measured in feet. In Europe the prevailing custom is to use girth (circumference) and length as the main units of dimension. The prevailing point for taking diameter measurements of standing trees is at breast height, that is, 4½ feet above the ground. Its usual abbreviation is D. B. H.



Courtesy of U. S. Forest Service

Fig. 32. Estimating the Saw Timber in a Pine Tree by the use of a tree scale, or cruiser's stick: A. If the stick is held horizontally against the trunk of the tree at a specified distance from the eye, the observer is able to read directly the diameter of the tree outside the bark. The standard is called the breast-high diameter, and is taken at a height of 4½ feet above the average level of the ground. B. The stick is graduated so that, when held a specified distance from the eye of the observer who stands a specified distance from the tree, the observer can read the number of 16-foot-log lengths in the tree. The principle is that of two similar triangles.

Basal area measurements are also used extensively, especially in research studies. It is the area, usually expressed in square feet, corresponding to the diameter dimension, usually expressed in inches, taken at any point of a tree's stem.

D. Units of Measure

1. *The Board Foot.* The board foot is the most widely used unit of measure in American lumbering and forest practices. It is represented by a board 12 inches wide, 1 inch thick and one foot (12 inches) long. For example, a board 12 inches wide, 1 inch

Courtesy of U. S. Forest Service

Fig. 33. Scaling the Amount of Saw Timber by the Use of a Log Scale Stick.

thick and 16 feet long contains 16 board feet. Boards less than an inch thick are usually estimated as if they were an inch thick. The content of logs is usually expressed in board feet, and lumber is also, as a rule, sold at a specified price per thousand board feet.

2. *The Cubic Foot.* In this country the cubic foot unit of measure is used chiefly in growth and yield studies and other research projects, and rarely in commercial transactions. It represents a block or cube of wood one foot high, one foot wide and one foot thick. For example, a block of wood three feet high, two feet wide and one foot thick contains 6 cubic feet. In Europe, the cubic meter is the commonest unit of measure used in forest practice.

3. *The Cord.* Fuelwood, pulpwood, acidwood, and sometimes peeled bark is measured and sold by the cord. The standard or stacked cord is a pile of wood 4 feet high, 4 feet wide and 8 feet long. It occupies 128 cubic feet of space, but actually does not contain 128 cubic feet of wood for a certain portion of each cord is occupied by air spaces. Under ordinary conditions a cord contains from 70 to 90 cubic feet of solid wood. Seasoning may reduce the actual wood content of a cord of green wood as much as 10 to 15 per cent. Fuelwood and pulpwood are sometimes cut in 5-foot lengths. When this is done a pile 4 feet high and 8 feet long contains 160 cubic feet. Such a pile is usually called a long cord. Firewood is often cut in 12, 14 or 16 inch lengths and set up in ranks 4 feet high and 8 feet long. Such a pile is generally called a short cord.

4. *The Piece.* The unit of measure may also be the individual piece. Poles, posts, ties, and mine timbers are often cut, measured and marketed on a piece basis.

E. Forest Mensuration Instruments

Many different kinds of instruments are required in forest mensuration. Some of them are also used in plane surveying, while others are designed especially for the measurement of the volume and growth of logs, trees, stands, and forests. Among the most important forest mensuration instruments are:

1. Instruments for measuring diameter:
   a. calipers
   b. diameter tape
   c. biltmore stick
   d. dendrometer (at heights above the natural reach of observer)
2. Instruments for measuring height:
   a. hypsometers (height measurers)
   b. abney level
   c. measuring tape
   d. measuring pole
3. Instrument for measuring volume:
   a. scale stick
4. Instruments for measuring growth:
   a. increment borer
5. Bark gauge (measure)

F. Log Rules and Scaling

A log rule is a tabulated form, often sanctioned by custom and sometimes designated by law, giving the volume contained in logs of specified diameters and lengths. The volume is usually expressed in board feet, but is also given in terms of cubic feet and cords. A large number of widely used log rules have been developed. Among them are The Doyle, The Scribner, The Scribner Decimal C, The Spaulding, and The International. The Scribner Decimal C Rule has been adopted for timber sales on the national forests. The following table lists the contents in board feet of logs of selected diameters and lengths as given by the International Log Rule for saws cutting one-fourth inch kerf:

LENGTH OF LOGS (FEET)	DIAMETER IN INCHES									
	8	10	12	14	16	20	24	30	40	44
	BOARD FEET									
8	15	30	45	65	85	135	205	325	595	725
10	20	35	55	80	110	175	255	410	750	910
12	25	45	70	100	130	210	310	495	900	1,095
14	35	55	85	115	155	250	370	585	1,060	1,290
16	40	65	95	135	180	290	425	675	1,220	1,480
18	45	75	110	155	205	330	485	765	1,380	1,675

Scaling is the measurement of the contents of logs for the purpose of ascertaining their volume. This is usually done by means of a scale stick, which is lath-like or rectangular in shape from 3 to 4 feet long, and has a log rule or table stamped upon it. On one edge the inches are marked and on the other edge and on the sides the volume values are placed according to specific log rules. The volume is read direct from the stick. No separate tables are required. Instructions for the scaling of national forest timber can be purchased in booklet form from the Superintendent of Documents, Washington, D. C.

G. Volume Tables

Volume tables are tabulated statements showing the average contents of different sizes of a given tree species. They are helpful in estimating standing timber, and are now available for many of our common trees. They can be expressed in board feet, cords,

cubic feet or in the number of posts, poles, ties or other units of measure. Volume tables give the volume of standing trees, while log rules are used to obtain the volume of logs or parts of felled trees.

VOLUME TABLE OF DOUGLAS FIR

PLUMAS AND SHASTA NATIONAL FORESTS, CALIFORNIA

Curved **Scribner Decimal C**

Diameter Breast High (Inches)	Averages for all heights	Total Height of Tree (Feet) 40	50	60	70	80	90	100	110	120	130	140	160	180	200	Diameter Inside bark of top (Inches)	Basis no. of Trees
		Volume Board Feet in Tens															
10	10	1	3	6	10	13	15	18	19	...	...	...	...	...	...	7	...
12	12	2	4	7	11	14	17	20	21	23	...	...	...	...	...	7	...
14	15	3	6	9	13	16	19	22	25	27	28	...	...	...	...	7	17
16	19	4	7	11	15	19	22	26	29	31	34	36	...	...	...	8	18
18	25	5	9	13	18	22	27	42	36	39	42	46	...	...	...	8	41
20	35	7	11	15	20	26	32	38	44	19	51	58	...	...	...	8	69
22	46	8	12	17	23	31	38	46	53	60	67	73	89	...	...	8	70
24	60	9	14	19	26	36	45	54	63	72	81	89	106	...	...	9	87
26	76	..	15	21	29	41	53	64	74	85	96	105	125	...	...	9	81
28	94	..	17	24	33	47	62	71	86	99	111	122	118	187	...	9	94
30	115	..	..	26	36	53	72	86	99	114	127	139	172	215	...	9	54
32	137	..	..	28	39	59	82	99	114	129	143	157	197	245	...	9	61
34	162	..	..	..	43	65	94	114	130	145	161	177	223	272	...	9	57
36	189	..	..	..	47	72	105	130	147	163	189	200	250	300	353	9	46
38	219	..	..	..	..	79	117	146	164	182	209	229	278	330	384	10	43
40	251	..	..	..	..	..	129	163	182	202	234	257	307	361	415	10	41
42	286	..	..	..	..	..	142	180	200	227	252	285	337	393	449	10	24
44	326	..	..	..	..	..	....	196	221	257	284	315	367	426	485	10	30
46	368	..	..	..	..	..	....	213	242	291	320	345	400	461	523	10	22
48	414	..	..	..	..	..	....	...	263	327	353	377	435	500	567	10	15
50	467	..	..	..	..	..	....	...	285	358	386	411	473	543	616	11	9
52	521	..	..	..	..	..	....	...	...	389	420	445	513	590	670	11	3
54	576	..	..	..	..	..	....	...	...	421	455	480	555	640	730	11	6
56	634	..	..	..	..	..	....	...	...	455	489	515	600	692	795	11	4
58	692	..	..	..	..	..	....	...	...	...	523	550	645	747	862	11	1
60	752	..	..	..	..	..	....	...	...	...	558	588	690	804	933	11	1
																	884

Courtesy of U. S. Forest Service

Average stump height, 1.9 to 2.8 feet.
Logs scaled in commercial lengths as cut.
Figures outside heavy lines are from extension of original tables.

H. Timber Cruising

The actual volume of wood in a forest cannot be determined exactly until the trees composing it are felled, sawed up and the contents of their products computed. Such a procedure is, as a rule, not satisfactory. Therefore a number of different methods of cruising standing timber have been developed, some of which are in rather wide use. Two distinct and yet complementary, methods are necessary to determine the contents of stands and larger forest areas, namely:

1. Determination of the area (acreage) of the stand or forest.
2. Measurement of the tree volumes growing on the area.

In the early lumbering days most of the timber estimating was done without the use of instruments. Such estimates are known as ocular estimates. They are rapidly being replaced by more accurate methods of estimating.

Two kinds of volume estimates are now in use, namely, total estimates and partial estimates. Total estimates require the measurement of every tree on an area. This is the most exact method of estimating, but the time required, the expense involved, and other limiting factors prevent its general use, except in case of special studies. Experience has shown that the partial estimate is usually satisfactory for general forest estimates. By this method selected samples, judged to be representative of the whole area, are measured and from the results, the volume of the total area is estimated. Satisfactory results have come from 10 to 20 per cent estimates, in which only 10 to 20 per cent of the total area is cruised. Sometimes an even lower per cent is used. The two principal kinds of sample areas used are:

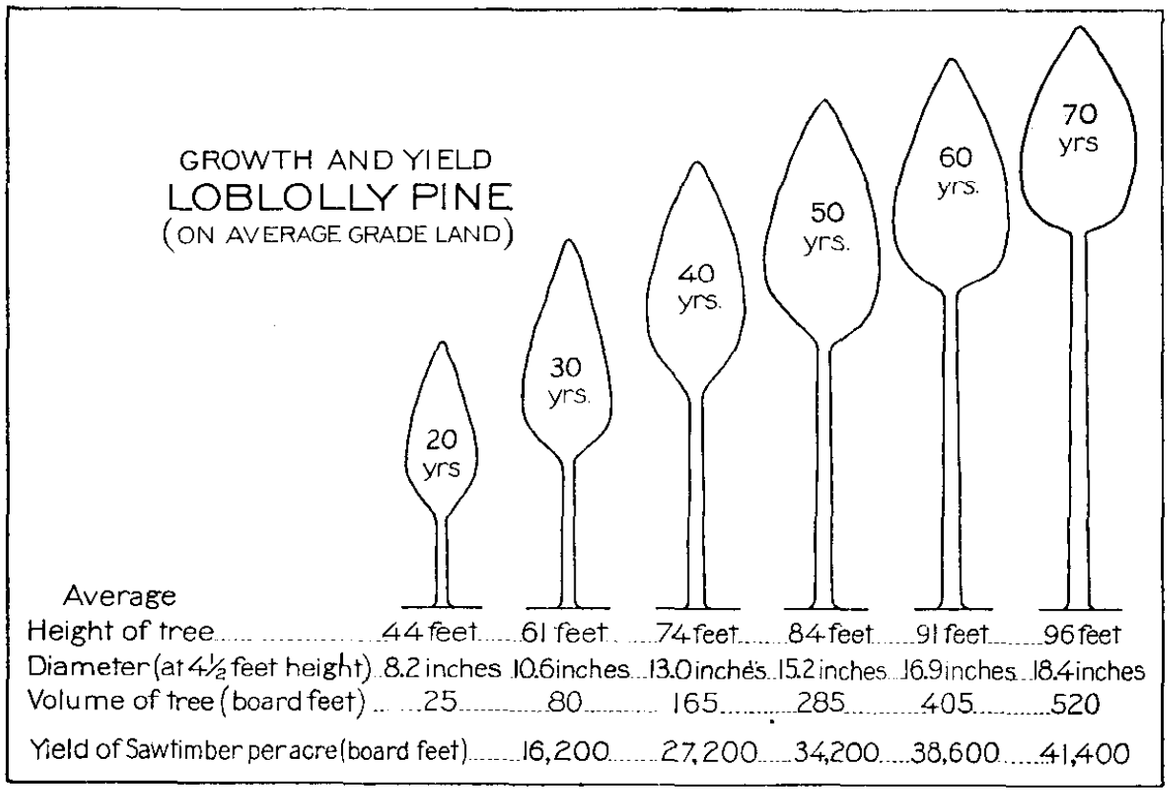
1. *Line plots.* By this method all the timber is estimated on a continuous line or series of plots, usually of uniform area, and placed arbitrarily along compass lines at specified distances apart. Plots are usually circular in outline and one-fourth acre in area.

2. *Strips.* By this method all the timber on strips of predetermined width, usually one chain or several chains in width, and run parallel to one another at specified distances apart, is tallied and estimated. This is one of the most widely used methods of timber estimating.

I. Yield Tables

A yield table is a tabulated statement showing the volume of wood per unit of area (usually per acre) attainable at different ages (usually in 10 or 20-year periods.) Yield tables are used extensively in Europe and a good start has been made in preparing them for use in this country. These tables have great practical and administrative values. They show what different forest stands will yield at different ages and are very essential in the establishment of a sustained yield plan of forest management so urgently needed in the United States. For growth and yield considerations forest stands are usually classified into one of four groups, namely, even-aged pure stands, even-aged mixed stands, uneven-aged pure stands, or

uneven-aged mixed stands. *Normal* yield tables are constructed separately for given species on different sites under different methods of stand treatment. They are used as standards with which to compare actual yields. Tabular statements giving the actual volume of specific stands are known as *local* yield tables.



Courtesy of U.S. Forest Service.

Fig. 34. Growth and Yield of Loblolly Pine on Average Land in Southern States.

The following yield table shows the average and maximum volume growth of the Beech-Birch-Maple type in northern Pennsylvania.

	AVERAGE VOLUME PER ACRE		MAXIMUM VOLUME	
Age (Years)	*Cubic Feet*	*Cords**	*Cubic Feet*	*Cords**
10	425	5.00	450	5.29
20	1,200	14.12	1,400	16.47
30	2,375	27.94	2,700	31.76
40	3,375	39.70	3,650	42.90
50	4,025	47.35	4,300	52.94
60	4,425	52.05	4,660	54.82
70	4,650	54.70	4,900	57.64
80	4,800	56.47	5,050	59.41

* Converting factor from cubic feet to cords is 85 cubic feet equals one cord.

II. THE MARKETING OF FOREST PRODUCTS

A. Different Marketing Methods

The successful marketing of forest products is as important as the economical production of forest crops. Many different marketing methods and combinations of methods are in use, ranging all the way from free use permits, through very nominal charges to local users, to full charges in commercial transactions. Among those in general use are:

1. Selling the timber and the land.
2. Selling all the timber without the land (stumpage).
3. Selling selected timber only (selection cutting).
4. Selling only damaged and inferior tree growth (improvement and salvage cuttings).
5. Selling cut logs, poles, posts, pulpwood and cordwood.
6. Selling special forest products, such as Christmas trees, decorative material, minerals, and the privilege of gathering nuts, picking berries, tapping maple trees, and collecting resin.
7. Selling grazing privileges and water power rights.
8. Leasing recreation concessions.

Sometimes the person owning or managing a forest property prefers to market the forest products after they are manufactured into lumber or in the form of final products. The marketing of the manufactured forest products may take the form of:

1. Selling entire sawmill product.
2. Wholesale selling of lumber and other manufactured forest products.
3. Retail selling of lumber and other manufactured forest products.
4. Cooperative selling of lumber and other manufactured forest products.

B. Forest Service Timber Sales

In recent years, the U. S. Forest Service has become the largest single seller of timber stumpage. National forest timber cut under sales and land exchanges during the fiscal year 1937 totaled 1,290,610,000 board feet, an increase of more than 26 per cent over 1936. Receipts from timber totaled $2,849,382, an increase of $687,711 over the previous year. During 1937 there were more than 20,000 transactions covering the sale of products from the national forests. Transactions covering the sale of miscellaneous products such as Christmas trees, shrubs, burls, tanbark and turpentine totaled 1,214.

All merchantable timber on the National Forests, except that reserved for special purposes, is for sale to the highest bidder under certain regulations which guarantee the protection of regeneration, watersheds, wild-life and other essentials of sound forest

practices. If it is determined that the land is better suited to agriculture than forestry, the area may be clear-cut and the land then opened to settlement under the Forest Homestead Law. In the aggregate, this practice is applied to a relatively small acreage. The controlling policy in the sale of national-forest timber is sustained yield.

Every purchaser of National Forest timber must sign a strict and detailed contract which specifies where and how the timber is to be cut, and how it is to be measured, removed and paid for. The agreement specifies very clearly that no timber is to be cut except such as is marked by a forest officer. There are regulations covering unnecessary damage to young growth, high stumps, breast-high and top diameter limits, and fire control measures. Bonds must be posted for the faithful fulfillment of all the terms of the timber sale agreement, and the purchaser is also required to make a specified advance payment and additional payments at specified times. In general, the Forest Service determines the minimum stumpage rates by deducting from the existing average selling prices of lumber the logging and milling costs plus a fair rate for interest and other legitimate expenses.

The small timber sales constitute an increasingly important factor in supplying wood needs to local communities within and adjacent to national forests. During the depression the sales have not been confined to meeting purely local needs. Many families visiting the national forests over week-ends return home with considerable quantities of wood on automobile trailers for home uses. The charge for this kind of wood is nominal.

C. Free Use Permits

Free use of national forest timber may be granted to bona fide settlers, miners, rural residents and prospectors, for firewood, fencing, building and other domestic purposes. Usually not more than $20 worth of timber is granted annually to any one person. Transients may take dead timber for campfires and similar uses without written permits.

D. Special Use Permits

All uses of national forest lands and resources, except those provided for in regulations governing the disposal of timber and the grazing of livestock, are designated as special uses. Under this heading comes the occupancy of land for various purposes and the leasing of rights of way. Sites for summer homes may be rented on some national forests under special use permits. In 1937, 857,359 special use summer-home permittees and guests used the national forests.

E. State Timber Sales

The marketing of timber and other forest products from state forests is carried on similar to that on the national forests. In a few states the cutting of timber is prohibited on the state-owned forests (forest preserves) but most of them have laws permitting the cutting and marketing of forest products and some states already derive considerable income from their forests.

F. Private Timber Sales

Private timber sales on the whole are highly competitive. Large lumber companies have large sales organizations. The farmer on the other hand is poorly organized. The federal and state governments, through special forest extension units, have in recent years been giving very helpful services to the small private owner in marketing his forest products. These services cover the marking of the timber for cutting, proper cutting methods, profitable grading methods, when to sell, how to sell and how to prevent the deterioration of cut wood products. These services extend as far as the preparation of sample timber sale contracts and the offering of practical helpful suggestions in marketing methods.

G. Cooperative Marketing of Forest Products

The cooperative marketing of forest products intergrated with long time management plans, is a rather new undertaking in the United States. Forest land owners' cooperatives have been in existence for a long time in Europe, particularly in Finland and Sweden. Cooperatives designed primarily to convert forest products into cash have been functioning in a few places in this country. No serious effort has been made by these agencies to build up and maintain on a sustained yield basis the forest resources on the small woodland areas of their members.

Recently at Cooperstown, New York and at Groveton, New Hampshire, forest land owners' cooperatives have been organized with the members marketing forest products and sustaining the yield on their forest properties with the objective of increasing the income. The New Hampshire cooperative has a membership of approximately 500 farmers. It is estimated that it will do a half-million dollar business during 1939. The Cooperstown cooperative is erecting a plant for the purpose of manufacturing lumber and dimension stock.

The working plans of these cooperatives include:

1. The formation of a regular selling agency for the disposal of forest products.

2. The improvement of selling prices to correspond to the cost of sustained yield management.

3. The elimination of unnecessary middlemen charges.

4. The standardization of specifications and rules of measurement.

5. The setting up and maintenance of a cooperative system of financing.

QUESTIONS

1. What is forest mensuration? Is the measurement of growth and yield a part of forest mensuration?
2. What are the principal units of measure in forest mensuration? What is the difference between a board foot and a cubic foot?
3. Describe the different kinds of cords used in measuring forest products.
4. Name and describe briefly some of the principal instruments used in measuring trees, logs and other parts of felled trees.
5. What is a log rule? For what purposes is it used? What is meant by log scaling?
6. What is a volume table? a yield table?
7. Describe the different methods of timber cruising now in general use.
8. Describe several different methods of marketing forest products.
9. How does the U. S. Forest Service conduct timber sales?
10. What is a free use permit? a special use permit?
11. In what way do the states and the federal government help private owners market their forest products?
12. Tell about recent developments in the cooperative marketing of forest products.

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CHAPTER XXII

THE STRUCTURE AND USES OF WOOD

I. WHAT WOOD IS

A widely used dictionary defines wood as "the hard part of a tree between the pith and the bark," and a well-known encyclopaedia tells us that it is "the hard fibrous substance which makes up the greater part of the stem and branches of trees and shrubs beneath the bark, and is also found to a limited extent in herbaceous plants." The botanist and the wood technologist think of wood as a complex plant tissue making up the xylem part of vascular bundles and consisting chiefly of parenchyma, fibres, tracheids, and vessels. A well-known wood chemist says that wood consists of a ground work of a starch-like substance known as cellulose permeated by materials collectively known as lignin and it may also contain secretions such as resin, coloring matter, water, and small portions of minerals. Most foresters think of wood in terms of the uses and services rather than its structural features or technical properties. Wood is one of the most necessary and indispensable products of everyday life. In handling forest properties the main objective of the forester is to grow successive crops of wood that in quantity, quality, and value will be of the highest use and service to mankind.

II. THE STRUCTURE OF WOOD

Wood is so extremely variable, that to understand its structural features requires at least a general knowledge of tree growth.

A. Growth Rings

In temperate regions trees do not grow continuously throughout the year. They usually grow from early spring into summer and then remain dormant during the colder periods of the year. During each growth period they add a layer of wood on the outside of the last-formed wood layer and just within the bark. Each successive layer of wood is known as a *growth ring*, and when it represents a year's growth is called an *annual ring*. By counting these growth rings it is possible to tell the approximate age of trees. Sometimes two or more wood layers are added during a single growing season.

Such growth rings are known as *double* or *multiple* annual rings. Mature specimens of some of our common trees may have several hundred or as many as 500 annual rings and the Sequoias of California and the Cypresses of Mexico have as many as several thousand growth rings.

B. Springwood and Summerwood

Trees usually grow most rapidly in spring and then slow down considerably during summer. The first-formed, large-celled and less dense wood of each annual growth layer is called early or *spring* wood, and the late-formed, small-celled and denser part is known as later or *summer* wood.

C. Cambium

To the naked eye the bark of a tree appears to lie directly against the wood. This is actually not true for between the bark and the wood is a very thin growing layer known as the *cambium*. Each growing season the cambium produces a layer of wood and bark between the wood and the bark.

D. Sapwood and Heartwood

An examination of a cross-section of a tree stem or the end of a log usually shows an outer layer of light-colored and an inner zone of dark-colored wood. The former is called *sapwood* and the latter *heartwood*. The sapwood is made up of active cells, while the heartwood is essentially a dead core whose chief function is to hold up the stem and carry the tree crown. Some trees, such as black locust and chestnut, have a very narrow sapwood, while in others such as hemlock and basswood, it is difficult to distinguish the sapwood from the heartwood.

E. Porous and Non-Porous Wood

The wood of our common trees can be divided into two major groups, namely, those with pores and those without pores. The former are called *porous* and the latter *non-porous* woods. The porous are further subdivided into *ring-porous* and *diffuse-porous*. Common examples of each of these three groups are:

Non-Porous	*Ring-Porous*	*Diffuse-Porous*
The pines	The oaks	The maples
The spruces	The ashes	The birches
The firs	The elms	The beeches
The cedars	The hickories	The basswoods

In pine, hemlock, and other coniferous wood no pores occur, whence the name non-porous. In pine little white specks resembling pores are found. They are resin ducts and in structure are quite

unlike pores. In ring-porous woods larger pores are found in the springwood and smaller pores in the summer-wood. This arrangement of the pores gives a ring-like appearance. In diffuse-porous woods the pores are all rather small and scattered rather evenly throughout the spring and summer wood.

F. Resin Canals

Resin canals are a normal feature of such coniferous woods as pine, spruce, larch and Douglas fir. In a few trees, such as the sugar pine, the resin canals are visible to the naked eye on cross-sections of wood and often form brownish streaks on the sides of lumber. These resin canals are actually intercellular passages surrounded by secreting cells and are often filled with resin.

G. Other Features

Among other gross structural features of wood are *wood rays*. They are ribbon-like structures extending from the bark for varying distances towards the pith. On the cross-section of wood they appear as thin lines running at right angles to the growth rings. *Wood parenchyma* is another major element of wood. Its chief function is the storage and distribution of food.

The grain and texture of wood may also be of special interest. The grain refers to the structural arrangements of the wood elements. Wood may be fine, coarse, straight, curly, or gnarly grained. The texture denotes the variable size or quality of the wood elements. It is usually referred to as fine, coarse, uniform, smooth, etc.

H. Physical Properties of Wood

The principal physical properties of wood of interest to the average wood user are weight, strength, stiffness, toughness, hardness, and shrinkage. In addition there are such properties as color, lustre, odor, and taste. These physical properties vary widely from species to species and even from tree to tree. For example, the color of black walnut and red cedar is distinctive and so is the smell and taste of sassafras. The weight of wood is usually expressed in pounds per cubic foot, or in pounds per thousand board feet, or by what is known as "specific gravity." If the specific gravity of a certain wood is expressed as .56, as is that of hard maple, it means that a given volume of this wood weighs .56 times as much as an equal volume of water. Since a cubic foot of water weighs 62.5 pounds, a cubic foot of hard maple weighs .56x62.5 or 35 pounds. In comparison, northern white cedar—the lightest common commercial native wood—weighs only 18 pounds per cubic foot and osage orange—the heaviest common commercial native wood—weighs 48 pounds per cubic foot, when oven-dry.

III. THE TREATMENT OF WOOD

A. Seasoning

Freshly cut timber often contains approximately half its weight of water. Before the timber is in shape for general use a large proportion of this excess water must be removed, and this process is called seasoning. There are two widely used methods of seasoning timber, namely the natural (air drying) and the artificial (kiln-drying) methods. Air drying usually takes from several months to a year or more. Kiln-drying can be done in a few days to several weeks. The principal reasons for the seasoning of wood is to reduce its weight, to fit the conditions of use, and to avoid shrinkage trouble. The extent of weight reduction in seasoning can be shown in hard or sugar maple. Its average green weight per thousand board feet of rough random-width one-inch lumber is 5,400 pounds; its air-dry weight is 3,900 pounds and when kiln-dried weighs approximately 3,000 pounds per thousand board feet.

B. Wood Preservation

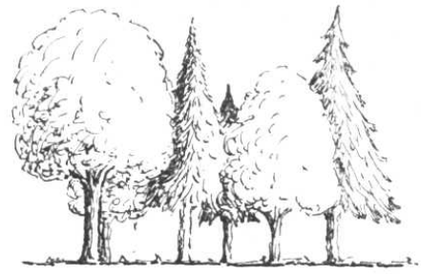
Some kinds of wood rot quickly while others are very resistant to decay. The latter are called *durable* woods. Among the woods that possess natural durability are the cedars, cypress, redwood, osage orange, and black locust. It is possible to extend the life of the durable and the less durable woods by treating them with preservatives, which are antiseptic substances and are poisonous to decay-producing fungi. Among the most widely used preservatives are creosote and zinc chloride. Statistics show that timber treating plants used 155 million gallons of creosote, 23 million gallons of petroleum, and more than 4 million pounds of zinc chloride in 1936. Among the products treated were 38,000,000 railroad ties, 19,000,000 linear feet of piling, more than 3,000,000 poles, and more than 245 million board feet of construction timber.

The three principal methods of applying preservatives are the brush method, the open-tank method, and the pressure method. The brush method is only a superficial treatment and gives but slight added life. The open-tank method is quite effective if properly applied. Maximum life, often several times that of the untreated wood, is possible by the pressure method which is the most commonly used commercial method of wood treatment. There is abundant evidence of the long life of treated timber. Tie tests by the *Chicago, Burlington and Quincy Railroad*, covering 20 different species, showed that after 18 years of service, 90 per cent of the untreated ties had been removed because of decay and only 10 per cent of the creosoted ties had been taken out of the tracks for this cause. The first successful wood preservation plant was established in this country in 1876. In 1904 there were 35 such plants, and now there are more than 200 plants that annually turn out more than 222 million cubic feet of treated timber.

PRODUCTS OF FOREST TREES

DIRECT PRODUCTS

Fuel Wood
Christmas Trees
Acorns and Nuts
Fruit (Berries, Cherries)
Decorative Material



CONVERTED AND DERIVED PRODUCTS

UNMANUFACTURED PRODUCTS

Pulp Wood
Extract Wood
Bark
Resins, Gums
Sap (Maple)

LOGS

Fuel Wood
Mine Timbers (round)
Poles
Piling
Posts

SEMI-MANUFACTURED PRODUCTS

Wood Pulp
Tannins
Acids
Dyes
Oils
Rosin, Pitch
Charcoal

Lumber
Cross Ties
Switch Timbers
Beams
Girders
Billets
Bolts

Veneer Blocks
Cooperage Stock
Cants
Flitches
Squares

MANUFACTURED PRODUCTS

Wood Pulp
Cellophane
Rayon
Gun Cotton
Lacquers
Vulcanized Fiber
Magazine Paper
News Paper
Book Paper
Wrapping Paper
Tissue Paper
Paper Plates
Leather (artificial)
Wood Flour

Lumber
Timbers
Rafters
Joists
Studding
Flooring
Moulding
Paneling
Doors
Frames
Lath
Shingles
Fixture
Furniture

Barrels
Baskets
Boxes
Crates
Caskets
Tanks
Ladders
Handles
Pipes
Pencils
Toothpicks
Matches
Toys
Spools

Fig. 35. Many Different Kinds of Products Used in Our Everyday Life Come From Forest Trees.

C. Other Treatments

Painting of wood, in addition to its decorative qualities, also acts as a preservative by closing up the pores and by preventing the entrance of moisture and the spores of wood-decaying fungi. Considerable opposition has developed from time to time against wood as a building material because of its high inflammability. This situation stimulated studies to devise effective methods of fire-proofing woods. Extensive experimentation in this field at the U. S. Forest Products Laboratory and other institutions has resulted in developing a number of effective fire-retardant paints and other fire-proofing materials.

IV. THE USES OF WOOD

Few people realize how intimately and extensively wood enters into our everyday lives. Look wherever we will and there is evident the importance of wood. See page 190 for the major uses of wood with the estimated amount used annually over the five year period 1925-29. Of the 14,000,000,000 board feet of lumber produced in 1933 about 63 per cent was used for construction purposes, and another 9 per cent for millwork such as sashes, doors, and other planing mill products. An additional 13 per cent was used in boxes and crates, 3 per cent in car construction, 3 per cent in furniture, 3 per cent in vehicles, and 6 per cent in miscellaneous factory uses.

A. Lumber Used in Manufacture

The U. S. Forest Service reports the following amounts of lumber used in 1933 by wood-using industries:

Lumber Uses	*Amount Used (1933) (Thousand Board Feet)*
Airplanes	357
Agricultural implements	17,797
Boot and shoe findings	36,987
Boxes, baskets and crates	2,901,411
Boxes, cigar and tobacco	28,967
Butchers' blocks and skewers	6,057
Car construction and repair	332,156
Caskets and coffins	125,662
Conduits, pumps and woodpipe	3,188
Dairymen's, poulterers' and apiarists' supplies	30,431
Dowels	2,313
Electrical equipment	17,548
Firearms	3,648
Fixtures	40,530
Flooring	433,021
Furniture	746,574

Lumber Uses	*Amount Used (1933) (Thousand Board Feet)*
Handles	115,586
Instruments, musical	9,152
Instruments, professional and scientific	4,118
Kitchen cabinets	8,983
Ladders	9,581
Laundry appliances	23,858
Machinery	1,947
Matches	85,278
Patterns and flasks	32,727
Pencils and penholders	14,167
Pipes, tobacco	70
Playground equipment	1,576
Plumbers' woodwork	5,263
Printing material	2,612
Pulleys and conveyors	34
Radio and phonograph cabinets	25,351
Refrigerators	49,234
Rollers, shades and maps	6,847
Sash, frames, doors and general millwork	572,794
Sewing machines	4,980
Ship and boat building	35,757
Shuttles, spools and bobbins	30,420
Signs	8,679
Sporting and athletic goods	8,006
Tanks	22,929
Toothpicks	500
Toys	21,316
Trunks and valises	5,953
Vehicles, motor	202,156
Vehicles, non-motor	15,127
Woodenware and novelties	59,920
ALL INDUSTRIES	6,111,568

This total wood requirement of all industries in the United States is classified as follows:

Lumber Uses	*Amount Used (1933) (Thousand Board Feet)*
Native Softwoods	3,681,689
Native Hardwoods	2,398,248
Foreign Woods	31,631
TOTAL	6,111,568

QUESTIONS

1. What is wood? Compare the different definitions of wood.
2. What is an annual growth ring? How can one tell the age of a tree?
3. How can one distinguish between spring wood and summer wood? between sapwood and heartwood? What is the function of the cambium?
4. Do all woods have pores? Name the two principal groups of porous woods.

5. What are the principal physical properties of wood? What is meant by specific gravity of wood. What is the heaviest native common commercial wood? the lightest?
6. Why is wood seasoned? Compare air-drying and kiln-drying of wood.
7. What are the advantages of wood preservation? What is the purpose of painting wood?
8. What was the total consumption of lumber in 1933 by all industries? What portion was used in the manufacture of boxes, baskets and crates?
9. How extensively is wood used in our everyday life?

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Chapter XXIII

CHEMICAL UTILIZATION OF WOOD

Wood comes to the builder and the craftsman as a finished or semi-finished product. To the chemist it comes as raw plant tissue, whose true usefulness can be determined only by a thorough discovery of its inward structure and substance.

An increasing quantity of wood is used annually in the making of products in which the identity of wood is not obvious. In addition well established products such as paper, rayon, cellophane, photographic films, fiber building boards, paper dishes, drinking cups, artificial leather and conduit pipes, a rapidly increasing number of newer articles used in everyday life are made from wood, such as alcohol, cattle food, eyeglass rims, fountain pens, poker chips, shoe counters and innumerable toilet articles. The wood substance used in the manufacture of these articles is made available or modified by a special treatment, or more often by a series of treatments, usually chemical in nature. In the realm of organic and physical chemistry lie unexplored possibilities not only of converting wood into manifold new products, but also of adapting and extending its established uses. The door of the chemical utilization of wood has been opened just a crack. Sometime the wood chemist will swing it wide open.

I. CHEMICAL COMPONENTS OF WOOD

To understand the great variety of products that can be made from wood, it is first necessary to know something about its chemical composition. While wood is a definite entity, its chemical makeup is by no means simple. Wood is a heterogeneous substance, fibrous in structure and made up of millions of minute cells.

About a century ago experimenters separated wood into its two main components—(1) a fibrous part, chemically similar to cotton, comprising the bulk of the cell wall substance and designated as *cellulose* and (2) a part called lignin, the essentially woody

component, which surrounds and permeates the cell walls as an encrusting or cementing matrix. In addition there exists in the tissues of the wood in some associative pattern, a considerable amount of intermediate substance, generally designated as *hemicelluloses*. Deposited in the cell cavities as a result of the physiological functions of the living tree are various substances, collectively termed *extraneous* materials.

Although the chemical composition of the wood of different tree species varies, the values are fairly within well-known limits. The greatest variation is in the extractives, which is only a few per cent in such woods as the spruces, firs and birches, while it is as many as 15 to 20 per cent in the southern pines, western larch and mesquite. The following figures give an approximation of the chemical composition of an average wood:

Substance	*Approximate Per Cent of Total Wood*
1. Cell Wall components:	
a. Cellulose	50
b. Hemicellulose	17
c. Lignin	25
2. Extraneous materials	8
	100

A. Cell Wall Components

The cell components of wood are often referred to as wood substance. They are sub-divided into the three classes listed in the above table. To cellulose, the chemist has not yet been able to assign a definite formula, but basically it is known to be similar to starch. But unlike starch, pure cellulose is rather resistant to chemical treatment. The carbohydrates, other than cellulose, are less resistant to chemical action and are relatively of little commercial importance. Lignin, which makes up almost one-third the weight of wood, is best defined as the non-carbohydrate fraction of wood, after it has been freed of tannins, resin, fats and other extraneous materials. Its exact chemical composition is not yet known, and there are relatively few uses for it. Ways have been found and described however, to compress lignin into wallboards and floor tiles, to get dyestuff from it, to derive an acid from it for bleaching clothes, to get a substance that acts as a binder for road materials and to manufacture vanilla extracts from it. At present lignin constitutes one of our greatest industrial wastes. The wood chemist is working zealously to open wider the door to the use of lignin.

B. Extraneous Components of Wood

The chemical components of wood which are not an integral part of the cell walls are usually called extraneous components of wood. They are also referred to as extractives. They include:

1. Resin
2. Tannins
3. Oils
4. Proteins
5. Certain carbohydrates (starch etc.)
6. Dyestuffs
7. Inorganic substances
8. Derivatives of organic acids
9. Medicinals

II. MAKING PAPER FROM WOOD

A. History

Paper making dates back to ancient times. Records show that the art of paper making was invented in China in 105 A.D. The first raw material was the inner bark of the mulberry tree. Later bamboo stems were used. The Arabs, about 800 A.D., began making paper from linen fibers. The product was so superior to paper made of wood fibers, that the use of tree products was discontinued for more than 1,000 years.

The first paper mill in the United States was established in 1690 by William Rittenhouse near Philadelphia. Until the early part of the 19th century paper was made entirely by hand, sheet by sheet, using rags as raw materials. The use of wood for modern paper making dates from 1840 when Keller patented a process for a woodpulp grinding machine in Germany but it was not placed on a commercial basis until 1854. In 1866 this mechanical wood pulp process was introduced in this country.

B. An Important Industry

The manufacture of pulp and paper is one of the major American industries. On the basis of the value of manufactured products, it is among the ten leading industries in the United States. In Canada it is the leading industry, both on the value of its products and the number of wage-earners employed in it. It is estimated that approximately 85 per cent of all the paper manufactured in America is manufactured wholly or in part from wood.

C. Distribution of Pulp and Paper Industry

Paper is made in considerable quantities in 37 states. Pulp mills are located in 26 of these states. In the United States and Canada in 1938, there are approximately 1,200 pulp and paper mills. Of this total 838 are paper mills and 370 pulp mills. New York

leads all other states with 126 paper mills and 53 pulp mills. Other leading states are Maine, Michigan, Wisconsin and Ohio.

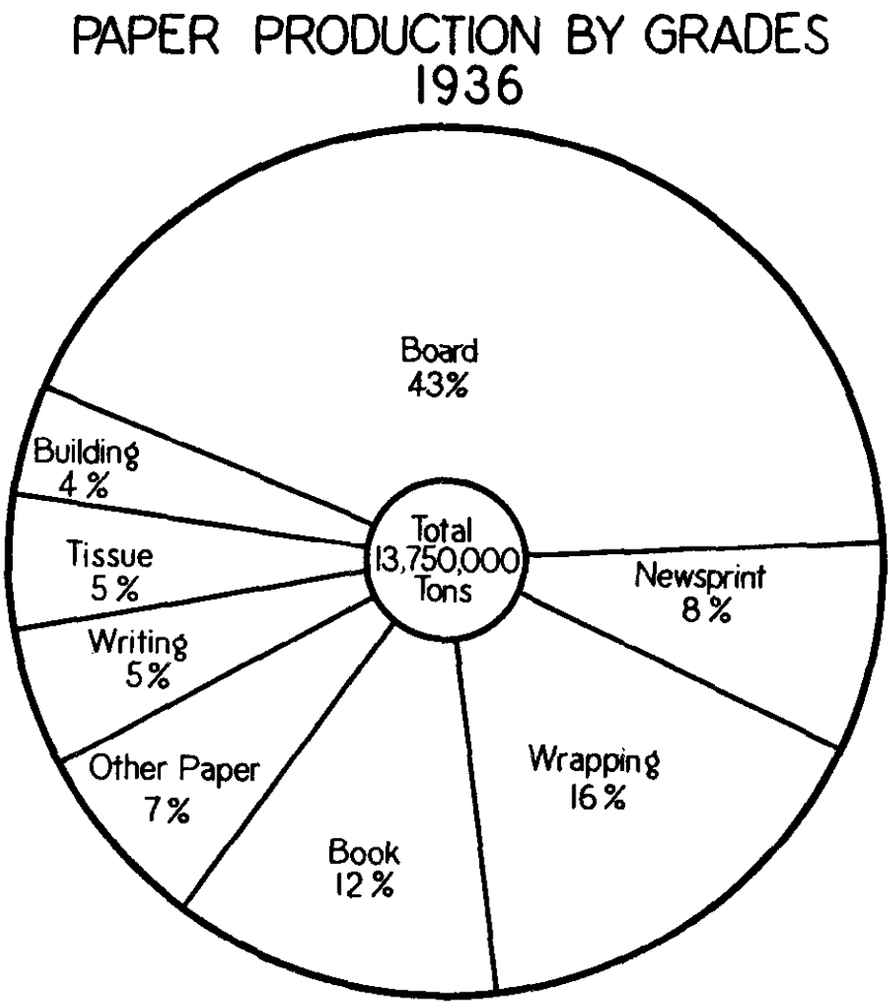

Fig. 36. Paper Production in United States by Grades—1936.

D. Pulp Mills Move Southward

In recent years there has been an extremely rapid expansion of the pulp and paper industry in the South. Large pulp mills are now operating in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Texas. Most of the southern pulp and paper mills were placed in operation in recent years. Some of them are among the largest and most modern in the country.

E. Four Principal Wood Pulp Processes

Wood is converted into pulp by two major processes, the mechanical and the chemical. In the mechanical or ground wood process the logs are held against a revolving grinder stone which tears the fibers from the logs, leaving the lignin and other substances mixed with the fiber. There are three main chemical processes, namely the sulphite, soda, and sulphate. In each process, the

chemical acts on the lignin and other encrusting materials, dissolving them and leaving the cellulose fibers free.

The quantity of wood used and the amount of pulp produced by the four major processes follows:

Name of Process	*Cords of Wood Used (1935)*	*Tons of Pulp Made (1935)*
Ground Wood	1,266,000	1,359,721
Sulphite	3,112,000	1,605,690
Sulphate	2,426,000	1,472,306
Soda	824,000	487,523 (a)

(a) Includes bleached and unbleached soda and semi-chemical.

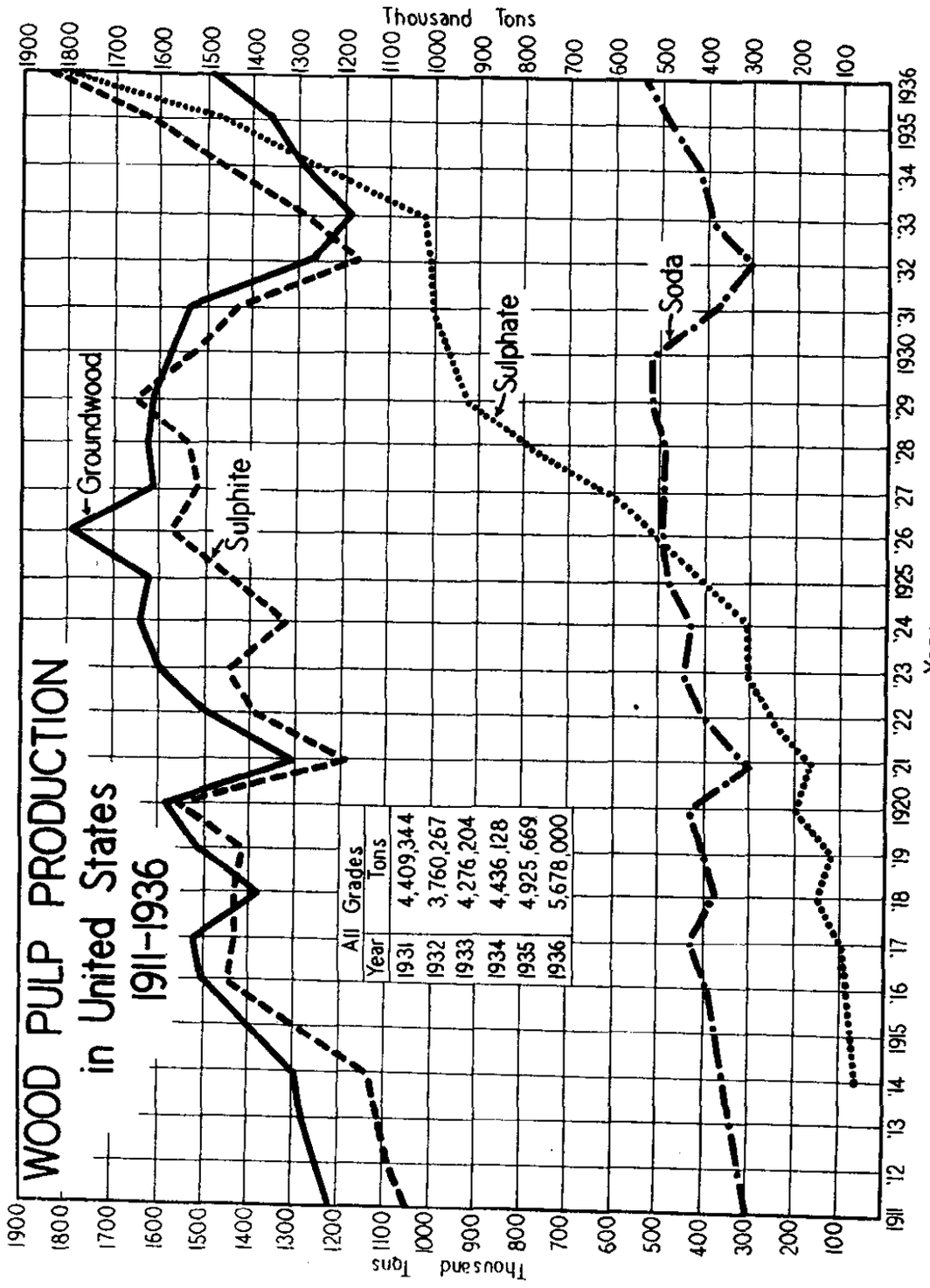

Fig. 37. Wood Pulp Production in United States (1912-1936) by Groundwood, Sulphite, Sulphate and Soda Processes.

The U. S. Pulp Producers Association estimated that in 1936, 1,496,000 tons of ground wood, 1,830,000 tons of sulphite, 1,817,000 tons of sulphate, and 535,000 tons of soda pulp were produced.

F. Mechanical Pulp Process

This process, as its name implies, depends wholly on a mechanical disintegration of the wood, no chemicals being used. The three principal woods used in this process in this country are spruce, hemlock and balsam fir. The mechanical pulp represents the lowest grade of paper making fiber. It is used chiefly in the manufacture of cheap papers like box boards, wall boards, wrapping papers, wall papers and newsprint. Ordinary newsprint consists of approximately 80% mechanical pulp and 20% sulphite pulp.

G. Sulphite Pulp Process

This is an acid chemical process, the active pulping chemical being sulphurous acid and its calcium salt (calcium bisulphite) in aqueous solution. The three principal woods used in this process in this country are spruce, hemlock and balsam fir. Sulphite pulp is used in combination with mechanical pulp in nearly all cheap papers to give them strength, and alone or mixed with rag fibers to make bond, ledger and writing papers.

In the sulphite pulp process enormous quantities of wood substance is wasted in the form of waste liquor which contains the non-cellulosic portion of the wood. Almost one-half of the wood used in this process goes annually in our streams and rivers as waste products. This is unquestionably one of the most enormous economic wastes in any American industry.

H. Soda Pulp Process

The soda process is an alkaline chemical process, which depends upon the solvent power of caustic soda for converting the non-cellulose components of wood into soluble form. The principal woods used in this process in this country are poplar, fir, gum, beech, birch, and maple. This process is especially applicable to the pulping of hardwoods. Rarely is soda pulp used alone to make paper. It is usually mixed with sulphite pulp to give it strength, and is used largely in the manufacture of book and magazine papers, its short, chunky fibers making the paper soft and opaque for printing. On the whole, it is the least important of the wood pulp processes. Its place is gradually being taken by the sulphate process.

I. Sulphate Pulp Process

This process is similar to the soda process except that the source of the alkali in the liquor is salt cake (sodium sulphate) instead of soda ash (sodium carbonate). The action of sulphate liquor on wood is very rapid and less destructive to the strength of cellulose than any other chemical cooking liquor. The sulphate process is well suited to the pulping of resinous woods such as pine. The principal woods used in the sulphate process in this country are southern yellow pine, jack pine and hemlock. This process is well suited to the making of pulp for strong tough papers such as are used as wrapping papers and for paper bags. The resulting paper is sold under the name "Kraft" paper, and is used widely in the manufacture of washable fabrics such as aprons, sacks, overalls, and artificial shoe leather.

J. Rayon

Synthetic fibers of cellulose, modified and spun into silk-like filaments, strands and yarns, are among the outstanding contributions of the twentieth century in the field of textile manufacture. These fibres, now generally known as rayon and formerly called artificial silk, are woven into a great variety of fabrics with which the American public is now thoroughly familiar. In 1935 the rayon consumption in the United States reached a total of more than 256,000,000 pounds. This is four times the consumption of silk, 60 percent of that of wool, and about 9 percent of that of cotton. More than 60 percent of rayon is now produced from purified wood cellulose. Present developments indicate an increasing use of wood for this purpose in the near future.

K. Fibre Boards

One of the largest items of paper production in the United States is fibre boards. In 1936 fibre board comprised 43 percent of all grades of paper production. It is used in the form of wall boards, insulation boards, hard pressed boards, panels, table tops and many other articles of everyday life. The manufacture of fibre board is rapidly developing into an enormous industry, the methods of which are partly chemical and partly mechanical.

III. WOOD DISTILLATION

By heating wood in the absence of air, decomposition of cell wall and extraneous material takes place, resulting in the formation of charcoal and such chemical products as wood alcohol, acetone and tar. The first distillation of wood on a commercial scale in this country was made in 1830 in North Adams, Massachusetts when James Ward began the manufacture of pyroligneous acid (a substance which on further treatment yields acetic acid, wood alcohol

and small quantities of acetone and tar). At first the distillation process was very crude and wasteful. In time there were notable improvements, more efficient methods and equipment were developed and the industry grew to a large size. Up to 1900 the industry was centered chiefly in New York. Thereafter it was extended to Pennsylvania and the Lake States. Some of the large wood distillation plants use up to 150 to 200 cords per day. During the war this industry flourished, but since then it has declined rapidly. At its peak more than 1,000,000 cords of wood were used annually in this industry. In 1923, in Michigan alone 434,163 cords of wood were used for this purpose.

Hard and heavy woods are most suitable for distillation purposes. Beech, birch, and maple are favored. Ash, oak, and hickory are almost as good. Chestnut contains too much tannin and cherry and elm contain too much gummy material. A cord of wood (128 cubic feet) when destructively distilled will produce:

Wool alcohol (crude)	10 to 11 gallons
Acetate of lime	180 to 210 pounds
Charcoal	900 to 1,000 pounds
Tar	25 gallons
Gas	11,500 cubic feet

Wood alcohol is used as a solvent in the paint and varnish industry and in the manufacture of other organic chemicals. Acetic acid, derived from acetate of lime, is used in the manufacture of solvents for lacquers, artificial silk, textile dyes, white lead and leather tanning. Charcoal is used as fuel in blast furnaces, gasoline refining and sugar refining, and tar is used as a preservative and as a filler in the rubber industry.

Increased competition from synthetic acetic acid and acetone has resulted in a marked decrease in their production by distillation of wood. Several methods, however, are being utilized at present to obtain acetic acid directly from pyroligneous acid, employing the extraction principle, and these offer good prospects of bringing back the industry. By far the larger volume of wood used for distillation purposes is hardwoods, but a considerable quantity of softwood is also used. Pine oils, rosin and turpentine are among the principal products derived from softwood distillation.

IV. WOOD EXTRACTS

A. Tannins

Tannins are amorphous powders, soluble in hot water, very astringent to taste, and found in the bark, wood and other parts of plants. The chief sources of tannin are:

Domestic	*Foreign*
Bark of hemlock	Quebracho wood, South America
Bark of some oaks	Wattle bark, Australia
Wood of chestnut	Myrobalans (nuts), India
Leaves and twigs of Sumac	Mangrove bark, East Indies, Central and South America

Tannins are used extensively in the tanning of hides for leather, in the manufacture of ink and as a mordant to fix basic aniline dyes.

B. Natural Dyestuffs

Natural or vegetable dyestuffs formerly occupied an important place in the dye industry. As late as the World War period the yellow inner bark of black oak (Quercus velutina, Lambert) was used in the dyeing of khaki colored cloth. Synthetic or coal tar dyes prepared from petroleum have displaced them and are now used almost exclusively. Among the important natural dyestuffs still used are logwood, brazil-woods, fustic, red sandalwood, quercitron and Venetian sumac.

C. Essential Oils

Essential oils, sometimes called volatile oils, are responsible for the odor and flavor which characterize certain woods, barks, leaves, and berries. In the United States they are produced chiefly from coniferous woods. Spruce, hemlock, and pine oil are well known. They are used for pharmaceutical supplies, insecticides and as cleansing agents. A variety of tropical oils are used in the manufacture of perfumes and flavors.

D. Naval Stores

Naval stores form another important group of substances obtained from wood. They are discussed in Chapter XX.

E. Medicinals

Many medicinal products are derived from forest trees and other vegetation of the forest. Among these products are camphor, cascara, castor oil, storax, quinine, pine resin, spruce gum, Canada balsam, birch oil, and benzoin.

V. WOOD PLASTICS AND OTHER PRODUCTS

A. Wood Plastics

Wood can be plasticized by various chemical treatments followed by molding under heat and pressure. It is thought that lignin is the principal plastic component. Wood and lignin plastics have good strength and hardness, polish well and have many other valuable properties. There is much investigation and development work in this new and rapidly growing industry.

The greatest outlet for wood in the plastics industry is as a wood flour filler in phenolic base molding resins. Wood pulp is also used as a filler or base by mixing with certain resins. By the use of suitable binders, ground wood shavings and sawdust are used to make numerous articles such as doll heads, furniture ornaments, numerous novelties, tiles, insulation materials and various cast products.

B. Wood Gas

The use of wood as a source of producer-gas for power and heat purposes has been intensively studied in Europe. Several automobile manufacturers make various types of vehicles equipped to operate on wood gas. It is reported that approximately 25 pounds of wood are equivalent to one gallon of gasoline. In Canada a new sawmill now obtains all its power from wood gas generated from wood waste.

C. Alcohol and Sugar

If wood is hydrolyzed by an acid glucose, sugar can be obtained. This sugar can be fermented into ordinary grain alcohol. In Germany two different processes have been developed for hydrolyzing wood. A yield of 63.5 gallons of absolute alcohol per ton of dry coniferous waste wood is reported. The unconverted sugar can be used as livestock food.

QUESTIONS

1. Name the three principal classes of chemical components of the cell walls of wood.
2. What is cellulose? What is lignin?
3. Name five well-known extraneous materials in wood.
4. When and where was paper invented? Where and by whom was the first paper mill established in the United States? In what part of the United States are most of the pulp and paper mills located?
5. Discuss the recent expansion of the pulp and paper industry in the South.
6. By what two general methods are the fibers in wood made available for use in paper? Name the four principal processes of making wood pulp. Which process uses the most wood? Which process produces the most tons of pulp?
7. By what process, or processes, is the pulp for newsprint made? book paper? wrapping paper? artificial shoe leather?
8. Discuss the rapid increase in the use of rayon in the United States.
9. How extensive is the use of fibre board in this country?
10. What forest products are used in the hardwood distillation industry? What widely used products are derived from them? Why did the center of production of this industry shift?
11. What products are derived from the distillation of softwoods?
12. Discuss briefly some common wood extracts with reference to their source, characteristics and uses.

13. What are some common medicinal products derived from forest trees and other forest vegetation?
14. Discuss the manufacture and uses of wood plastics.
15. Where and to what extent is wood used as a source of producer-gas for power and heat purposes?
16. Discuss the production of alcohol and sugar from wood.

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CHAPTER XXIV

RESEARCH IN FORESTRY

I. BEGINNING OF FOREST RESEARCH

As early as 1876 a federal law provided for the appointment of "some man of approved attainments to prosecute investigations and inquiries and to seek the basic knowledge necessary for the successful practice of forestry in the United States." What an enormous task for one man! In 1908 the first federal forest experiment station was established in the Coconino National Forest near Flagstaff, Arizona. The following year (1909) the Cloquet Forest Research Station was established by the State of Minnesota. In 1910 the Forest Products Laboratory was established at Madison, Wisconsin, by merging several small federal laboratories in different parts of the country. But it was not until 1915 that organized forest research really began. On June 1 of that year the Branch of Research was established in the U. S. Forest Service.

II. PURPOSE AND REQUIREMENTS OF FOREST RESEARCH

The purpose of forest research is to supply the basic and practical knowledge required for the best possible management of forest and range lands, and the best utilization of their products.

To provide and maintain satisfactory standards for forest research a number of essential requirements must be met. Among them are:

1. Worthful objectives
2. Competent staff
3. Effective field units and programs
4. Satisfactory working facilities
5. Adequate finances
6. Effective supervision and organization

None of these requirements are more essential than a competent staff of research workers. Years of experience have shown conclusively that research work cannot be done satisfactorily with mediocre or poor men. Instead, the very best men are required for this work. In some cases it has become necessary to employ men before they are adequately trained for research and then train them on the job. Special encouragement is occasionally given to research workers by granting them leave of absence from their work to take

additional training. Temporary summer employment of forest school undergraduates is also an effective means of giving research training to promising young men who are considering research as a career.

III. FIELDS OF FOREST RESEARCH

Forest research covers a wide range of problems, studies and activities, including the protection, growth, and management of forests, the management of livestock and wildlife areas within forest areas, the effective and wise utilization of forest products, production of lumber and other forest resources, present and future timber needs, and such economic and social problems as arise with forest ownership.

A wide range of forest management studies are the most common type of federal research projects. They are a part of the research program at all the federal forest experiment stations. Forest range investigations are in progress at six western stations, erosion and streamflow studies at seven stations, forest survey projects at five stations. Forest products investigations are centered at the Forest Products Laboratory, Madison, Wisconsin, with associated work at three experiment stations. The field of study varies considerably from region to region. In the South naval stores investigations are important, in the West grazing studies hold a prominent place, in the Lake States planting and fire control are in the front rank, and in the East the silvicultural treatment of inferior second-growth stands deserves special consideration.

IV. FOREST RESEARCH AGENCIES

A. Federal Agencies

The principal federal agencies engaged in forest research are the U. S. Forest Service, the Bureau of Entomology and Plant Quarantine, the Bureau of Chemistry and Soils, the Bureau of Land Economics, the Bureau of Biological Survey, the Bureau of Fisheries and the Weather Bureau.

B. State Agencies

The leading state agencies engaged in forest research are the state conservation and forestry departments, the state forest schools, other state educational institutions and state agricultural experiment stations. Annual expenditures for forest research by state forestry departments totals about $100,000. The state forest schools and other departments of state institutions expend annually about $165,000, and state agricultural experiment stations approximately $55,000. It has been estimated that the aggregate annual expenditures by all state agencies for forest research is about $443,000.

C. Quasi-Public and Private Agencies

Estimates show that almost $3,000,000 are being spent annually for forest research by quasi-public and private forestry agencies. About five-sixths of this amount is contributed by wood-using industries, and of these the pulp and paper industry is far ahead of all the others. The normal number of technical workers employed on wood-products research is about 350. There are about 200 laboratories in the United States carrying on research on lumber and other forest products. Other privately supported forest research projects are being carried on at endowed schools of forestry, college departments of botany and economics, large research foundations, research stations, arboretums, botanical gardens, corporations, and trade associations. Among these are the Yale School of Forestry, the Bussey Institution at Harvard, the Carnegie Institution of Washington, the Boyce Thompson Institute of Plant Research at Yonkers, N. Y., the Tropical Plant Research Foundation, Washington, D. C., the National Institute of Public Administration, New York City, and the National Lumber Manufacturers Association. The latter with its federated associations spends about $500,000 annually for research.

V. FOREST RESEARCH FIELD UNITS

Forest research requires a lot of field work. For this reason a large number of field units have been established. Among these are federal forest experiment stations, the federal forest products laboratory, state forest research institutions and stations, and research and demonstration forests.

A. Federal Forest Experiment Stations

The first federal forest experiment station was established in the Southwest in 1908. It covered the states of Arizona and New Mexico. The next year the Rocky Mountain Station was established, and the California station was put in operation in 1912. It was not until 1920 that the Forest Service began the establishment and organization of a series of forest experiment stations on a regional basis.

The federal forest experiment stations now operated by the Forest Service are:

Name	*Headquarters*	*Territory*
1. Allegheny	Philadelphia, Pa.	New Jersey, Pennsylvania, Maryland and Delaware
2. Appalachian	Asheville, N. C.	Va., W. Va., Eastern Ky. and Tenn., N. C., and S. C.

3.	California	Berkeley, Cal.	California and Western Nev.
4.	Central States	Columbus, Ohio	Ohio, Ind., Ill., Iowa, Missouri, Western Ky. and Tennessee
5.	Intermountain	Ogden, Utah	Utah, Nevada, Southern Idaho
6.	Lake States	St. Paul, Minn.	Mich., Wisc., Minn., N. Dakota and S. Dakota
7.	Northeastern	New Haven, Conn.	New England and New York
8.	Northern Rocky Mountain	Missoula, Mont.	Montana and N. Idaho
9.	Pacific Northwest	Portland, Oregon	Washington and Oregon
10.	Rocky Mountain	———	Neb., Kansas, Wyo., and Colorado
11.	Southern	New Orleans, La. Lake City, Florida. (Naval Stores Branch Station)	Ga., Fla., Ala., Mississippi, Ark., Louisiana, Texas and Oklahoma.
12.	Southwestern	Tucson, Arizona	New Mexico and Arizona

In 1936 another forest experiment station was authorized for the Great Plains region but as yet has not been established.

In 1915 the total allotment for federal forest experiment stations was less than $50,000. In 1938 the expenditures for research by the U. S. Forest Service amounted to more than $3,500,000. With the increase in appropriations there has been a corresponding increase in personnel. For example, the Southern Forest Experiment Station, established at New Orleans in 1921, had only seven persons on its staff as late as 1926. Now the regular and emergency personnel of this one station totals about 200.

B. The Forest Products Laboratory

Most of the forest products research of U. S. Forest Service is concentrated at the Forest Products Laboratory, established at Madison, Wisconsin in cooperation with the University of Wisconsin. It is a field unit of the research branch of the Forest Service and has as its broad objective the development of greater and more diverse service values for all forest products. The investigations of the laboratory cover a wide range of problems from cutting of a tree to the chemistry and microchemistry of wood. Wood testing is an important laboratory activity. More than half a million wood tests have been made and recorded. The results of these tests have been helpful in determining engineering standards for many wood uses. Other special studies relate to the seasoning of wood, the preservation, painting, moisture proofing and gluing of wood, better use of wood in construction and fabrication, the prevention of wood waste, and pulp and paper research.

Appropriations for the Forest Products Laboratory have increased rapidly since its establishment in 1910. The increase is shown in an appropriation of $130,744 in 1915 and $534,430 in 1932. In the latter year $900,000 was also made available for a new laboratory building. Each year since then substantial allotments were made to the laboratory.

C. State Forest Research Institutes and Stations

In a number of states forest research has progressed far enough to be set up in distinct units. Pennsylvania established a Forest Research Institute in 1930. New York has a special unit for forest investigations in its Conservation Department. Michigan has a Forest Fire Experiment Station at Roscommon. Maine is conducting intensive studies of forest insects. Minnesota maintains a Forest Research Station at Cloquet. A large amount of research by state agencies is being done at state forest schools, and at state agricultural experiment stations. At least 26 states are carrying on some research work that has to do with forestry or range management.

D. Research and Demonstration Forests

In recent years a large number of research, experimental and demonstration forests have been established. Educational institutions, states, and the federal government are actively participating in their development. The Harvard Forest at Petersham, Mass., the Yale Demonstration and Research Forest at Keene, New Hampshire, the Pack Demonstration Forests in New York and Washington, the Black Rock Forest at Cornwall-on-the-Hudson in New York, the Mont Alto State Forest in Pennsylvania, the Duke Forest in North Carolina, are just a few of the many research and demonstration forests that are being developed.

The federal forest service has also started to set aside specific forest areas for research or experimental purposes. These areas are called Experimental or Research Forests, and range in size from 500 to 18,000 acres, with an average of approximately 4,000 acres. Natural areas are usually classified separately from such experimental forests. Present plans call for the establishment of a complete system of these experimental forests in representative forest types in all parts of the country, probably from 5 to 10 in each major forest region. A considerable number have already been established. chiefly on the national forests. The rapid extension of forest land acquisition by the federal government in the East and the South has made possible the establishment of urgently needed experimental forest areas in these regions. In recent years the Crosset Experiment Forest was established in southern Arkansas, the Harrison in southern Mississippi and the Palustris in central Louisiana. These research forests serve not only as centers for experimentation, but also as demonstration areas of forest conditions and practices, and as training grounds for forestry personnel.

VI. THE McSWEENEY-McNARY FOREST RESEARCH ACT

The passage of this Act in 1928 formulated forest research objectives in at least the following three particulars:

1. It specifies what research may be done.
2. It sets up a series of research field units, including the Forest Experiment Stations and the Forest Products Laboratory.
3. It outlines a 10 year financial program.

This Act is directly responsible for the rapid growth of forest research in recent years, and for the first time appropriations began to approximate needs.

VII. RECENT MAJOR RESEARCH PROJECTS

A large number of research projects have been undertaken in recent years by many different agencies. The Branch of Research in the U. S. Forest Service is by far the largest and most effective forest research agency in the country. Some of the major projects now being developed by it are:

1. *The Forest Survey.* In 1930 a nation-wide forest survey was started. It aims to collect and interpret complete and authoritative information on the forest resources and forest requirements of our country. Considerable progress has already been made. Field work covering fifty-one million acres was completed in 1937 for the Pacific Northwest. About 50 per cent of the northern Rocky Mountains area has been mapped and inventoried. Field survey work in the Lake States is practically completed. Information has already been collected on 129 million acres in the South, and elsewhere considerable progress has been made.

2. *Forest Taxation Inquiry.* The formal report of this special inquiry was completed in 1934 and published in 1935.

3. *Tax Delinquency in Forested and Cut-over Regions.* The results of this study are urgently needed to shape sound land policies.

4. *Forest Fire Insurance.*
5. *Time and Cost Studies of Logging and Milling Operations.*
6. *Low Cost Housing and Rural Building.*
7. *Southern Hardwood Utilization.*
8. *Fibre Containers.*
9. *Plastics and Other Chemical Uses of Wood.*
10. *Pulping Tests of Southern and Western Woods.*
11. *Studies in Painting of Wood.*
12. *Erosion, Stream-flow, and Flood Control Studies.*
13. *Shelterbelt Planting in the Prairie States.*
14. *Range Investigations.*
15. *Forest Genetics.*

Under date of Nov. 1, 1938 a committee on Forestry of the National Research Council issued a report on "Forest Research in the United States" listing 1,308 forest research projects in all parts of the country. The projects are grouped under the general headings of forest botany, forest ecology, silviculture, forest mensuration, forest influences, forest protection, forest management and administration, forest economics, wood technology, forest products and utilization, forest range, and forest zoology.

VIII. THE FUTURE OF FOREST RESEARCH

The present trend of forest research is toward a more intensive and more comprehensive attack of forest problems in all fields of forestry. The results of research are needed to guide forestry in the right direction, so that it can be of the greatest service to mankind.

QUESTIONS

1. When did forest research begin in the United States?
2. What are some of the essential requirements of forest research?
3. Does the research worker require a special training?
4. Outline the different fields of forest research.
5. What are the principal federal forest research agencies? The principal state forest research agencies?
6. What quasi-public and private agencies are engaged in forest research?
7. Give the location and list some of the major activities of the federal forest experiment stations.
8. Describe the work of the Forest Products Laboratory.
9. Tell about the work of state research institutes and stations.
10. Why should special forest areas be set aside for forest research and demonstration purposes?
11. Of what importance is the McSweeney-McNary Forest Research Act?
12. What benefits are already coming from the nation-wide forest survey now in progress?
13. What are some of the important forest research projects now in progress in the United States?

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CHAPTER XXV

FOREST EDUCATION

I. BEGINNING OF FOREST EDUCATION

From the beginning of American forestry the collection and dissemination of information about forests and forestry has been an important activity at educational institutions and an essential function of public and private forestry agencies and organizations. As early as 1867 forest inquiry commissions were created in Michigan and Wisconsin. Among their chief responsibilities was the collection and dissemination of information about the forest resources of the State. Just five years later (1872) Arbor Day was started in Nebraska. Since then Arbor Day has become a nationwide instrument of education designed primarily for the development of a fuller appreciation and better understanding of our trees and forests. The same year (1872) James Arnold bequeathed $100,000 to Harvard University for the establishment of a professorship of tree culture and an arboretum. In 1873 a few lectures on forestry and tree culture were given at Yale to students in agricultural courses and in 1874 a course in forestry was instituted at Cornell. In 1877 Dr. Joseph T. Rothrock started a series of annual lectures on forest trees and forestry at the University of Pennsylvania, and in 1881 instruction in forestry was offered by Prof. Volney M. Spadling in the Department of Botany at the University of Michigan. In the original constitution of North Dakota adopted in 1889 authorization was given for the establishment of a school of forestry. At an election held in 1894 it was determined that the school would be located at Bottineau. In 1897 it was named the "North Dakota School of Forestry.

Prior to the beginning of professional education in forestry in the United States, forestry had gained recognition in agricultural education. At least twenty-two land grant colleges gave some instruction in forestry prior to 1897. During the latter part of the last century a number of foresters, most of whom had received their forestry training in Europe, began the promotion of forestry in the United States. Among them were Fernow, Pinchot, Roth, Graves, Price and Schenck.

II. KINDS OF FOREST EDUCATION

Since these early efforts in forest education, great progress has been made in many directions, and now the following principal kinds of forest education are generally recognized:

Professional Forest Education.
Pre-professional Forest Education.
General Collegiate Forest Education.
Semi-professional (Vocational) Education.
Special Forest Education.
General Public Forest Education.

III. PROFESSIONAL FOREST EDUCATION

The year 1898 marks the beginning of professional forest education in the United States. That year, the New York State College of Forestry was established at Cornell University under the direction of Dr. B. E. Fernow. Earlier the same year Dr. C. A. Schenck established the Biltmore Forest School at Biltmore, North Carolina. The school at Cornell was discontinued in 1903 and in 1912 the Biltmore school was closed. In 1900 the Yale Forest School was established at New Haven, Connecticut. It is now the oldest forest school in the United States.

A. Professional Forest Schools in United States

	School	*Location*	*Number of Students Enrolled (1st Semester 1937-38)*
1.	Univ. of California (1914)	Berkeley, Cal.	301
2.	Colorado State (1911)	Fort Collins, Col.	272
3.	Connecticut State (1923)	Storrs, Conn.	17*
4.	Duke University (1930)	Durham, N. C.	23*
5.	Georgia State (1906)	Athens, Ga.	173
6.	Harvard University (1904)	Petersham, Mass.	4
7.	Univ. of Idaho (1909)	Moscow, Idaho	346
8.	Iowa State (1912)	Ames, Iowa	284
9.	Louisiana State (1925)	Baton Rouge, La.	128
10.	Univ. of Maine (1903)	Orono, Me.	180
11.	Michigan State (1903)	East Lansing, Mich.	252
12.	Univ. of Michigan (1903)	Ann Arbor, Mich.	190*
13.	Univ. of Minnesota (1900)	St. Paul, Minn.	389
14.	Univ. of Montana (1914)	Missoula, Mont.	265
15.	Univ. of New Hampshire (1911)	Durham, N. H.	63
16.	N. Y. State College of Forestry (1911)	Syracuse, N. Y.	498
17.	North Carolina State (1929)	Raleigh, N. C.	179
18.	Oregon State (1910)	Corvallis, Ore.	444
19.	Penna. State (1903 and 1906)	State College, Pa.	396
20.	Purdue University (1926)	Lafayette, Ind.	130
21.	Univ. of Utah (1927)	Logan, Utah	256
22.	Washington State (1907)	Pullman, Wash.	138
23.	Univ. of Washington (1907)	Seattle, Wash.	355
24.	Yale University (1900)	New Haven, Conn.	60
		TOTAL	5,343

* Includes only enrollment of Junior and Senior years, graduate and special students.

In addition to the twenty-four forest schools listed above, several other institutions have undertaken the development of educational programs in forestry. In 1936 a Department of Forestry was established at the University of Florida. Two curricula are being developed there for training in forestry and conservation. One offers a short course of training for forest rangers. The other offers a four-year course leading to the degree of Bachelor in Science in Agriculture. The first semester of 1838-39, 16 juniors and 13 seniors were enrolled. In 1935 the University of West Virginia began to offer training in professional forestry. In the spring of 1937 a four-year course leading to the degree of Bachelor of Science in Forestry was established. A total of 85 students was enrolled during the first semester of 1938-39.

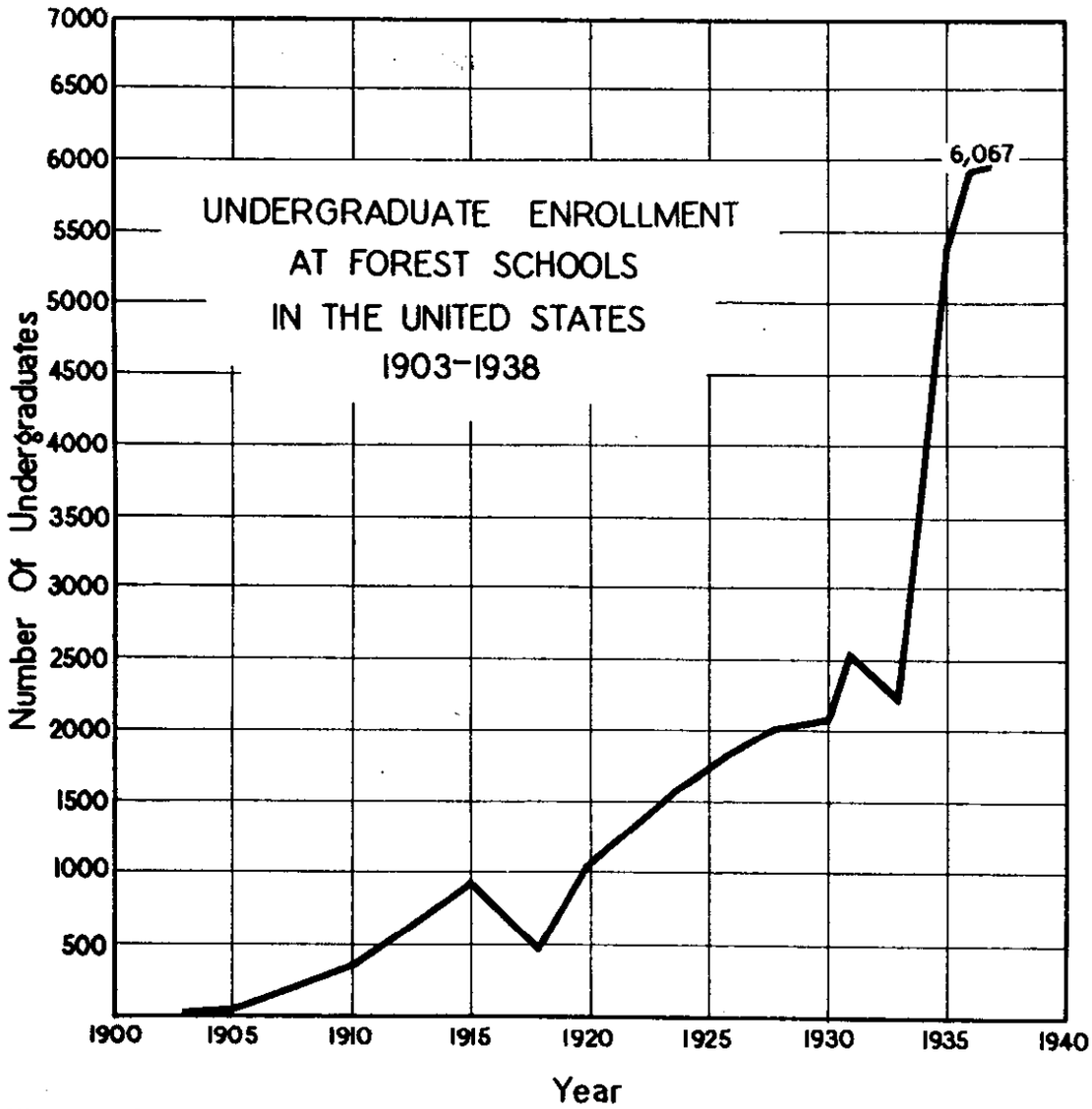

Fig. 38. Undergraduate Enrollment at Forest Schools in United States (1903-1938).

B. Growth of Forest School Enrollment in United States

Year	*Total Number of Undergraduate Students*
1903-04	19
1907-08	143
1910-11	518
1915-16	944

1918-19	498
1920-21	1,092
1930-31	2,120
1931-32	2,573
1932-33	2,388
1933-34	2,246
1934-35	3,791
1935-36	5,406
1936-37	6,032
1937-38	6,067
1938-39	5,144

The rapid increase in recent enrollment in the twenty-four professional forest schools of the United States is shown by classes in the following table:

Classes	*Number of Students First Semester*				
	1934-35	*1935-36*	*1936-37*	*1937-38*	*1938-39*
Senior	439	575	815	1,114	1,212
Junior	671	943	1,402	1,378	1,294
Sophomore	930	1,587	1,771	1,656	1,235
Freshmen	1,751	2,301	2,044	1,919	1,403
TOTAL	3,791	5,406	6,032	6,067	5,144

The foregoing table shows an astonishing increase in recent enrollment. In 1938 almost three times as many students were studying forestry in professional forest schools as five years earlier. It is noteworthy, however, that a decrease in enrollment in the freshmen class started three years ago and in the sophomore class two years ago. It is quite probable that this decrease will continue, for recent enrollment was abnormally high.

C. Subjects of Instruction at Forest Schools

1. *Preparatory Subjects.*

Botany	English Composition
Zoology	Literature
Geology	Public Speaking
Chemistry	History
Physics	Government
Mathematics	Citizenship
	Economics

2. *Pre-professional Subjects.*

Silvics (Foundations of Silviculture)	Wood Technology
Forest Soils	Timber Physics
Plant Ecology	Drawing
Taxonomy	Surveying
Dendrology (Tree Identification)	Mapping
	Accounting
	Statistics

3. *Professional Subjects.*

Forest Protection	Forest Administration
Forest Pathology	Range Management
Forest Entomology	Wildlife Management
Silviculture	Forest Recreation
Forest Mensuration	Forest Utilization
Forest Finance	Forest Economics
Forest Regulation	Forest Policy
Forest Management	Forest Law
	Forest History

D. Length of Professional Course

Most of the forest schools in the United States offer a four-year undergraduate course. For the majority of students the four-year course represents the entire school training period, but an increasing number of students are taking one or more years of graduate work. Two institutions, Harvard and Yale, are entirely on a graduate basis. Seventeen of the twenty-four forest schools in the United States offered graduate work during the first semester of 1937-38. That year a total of 184 graduate students were enrolled in the seventeen schools offering such courses. In 1938-39 293 graduate students were enrolled in seventeen schools. It is strongly recommended by some foresters and educators that the professional undergraduate forestry course be extended to five years.

E. Degrees

Fifteen forest schools award the degree of Bachelor of Science upon the satisfactory completion of all school work, and the remaining undergraduate schools award Bachelor of Science in Forestry. One of these schools also grants the degree of Bachelor of Forestry. The higher degrees awarded are Master of Forestry, Master of Science in Forestry, Master of Science, Doctor of Philosophy and Doctor of Science. Seven forest schools carry the graduate work to the doctor's degree.

F. Field Work

The majority of forest schools provide for at least one summer term of field work, usually from four to ten weeks. A few require a second period of field work. The latter is usually provided in the senior year. During summer vacations some students find employment on forests under the direction of experienced foresters. This type of employment is highly desirable. An increasing number of schools offer special field trips to important forests, forest operations, and forest industries.

G. Demonstration and Research Forests

Most forest schools now own, or through special arrangements have the use of, forests for study, research and demonstration purposes. A number of schools now have forests exceeding 10,000 acres.

These out-door laboratories are essential equipment for effective instruction in forestry. Other important considerations in determining the standards of forest schools are the teaching staff, laboratory equipment, libraries, and financial support of the institution.

IV. PRE-PROFESSIONAL FOREST EDUCATION

Several institutions, among them North Dakota School of Forestry at Bottineau, the Southern Branch of the University of Idaho at Pocatello, Massachusetts State College, Ohio State University and the University of Missouri offer special short courses in forestry subjects that enable students to transfer to a professional forest school with advanced standing.

V. GENERAL COLLEGIATE FOREST EDUCATION

Many institutions that do not provide a full professional course in forestry are offering courses of collegiate grade in forestry. Sixteen land-grant colleges, with which no forest schools are associated, are offering one or more forestry courses. Some liberal arts colleges and technical institutions, especially those owning considerable areas of forest land, also offer one or several courses in forestry. These courses are usually offered under the title of General Forestry, Forest Conservation, Conservation of Natural Resources, Tree Identification, and Forest Land Use.

VI. SEMI-PROFESSIONAL OR VOCATIONAL FOREST EDUCATION

A beginning has been made in the United States in providing semi-professional or vocational training in forestry. Only a few institutions are now giving this type of training designed to prepare men for subordinate positions in forestry. The State Ranger School, a branch of the New York State College of Forestry, located at Wanekena, N. Y., and the Pennsylvania State Forest School, located at Mont Alto, Pennsylvania offer one-year and two-year courses in forestry respectively. A short course for forest rangers was established at the University of Florida in 1936.

VII. SPECIAL FOREST EDUCATION

Many types of special forest education are now in use, most of which are vocational in nature and of relatively short duration. For some time the U. S. Forest Service has been conducting special training camps covering a wide range of subjects and activities, but usually pertaining to current problems. These special educational programs take the form of schools of instruction for forest rangers, forest fire wardens, forest inspectors, radio operators, stand improvement foremen, road construction foremen, erosion engineers, land use experts and many other lines of work and groups of personnel.

The duration of these schools ranges from several days to several weeks and occasionally for a full month or more. The form of education is now usually classified under In-service Training in Forestry.

Special tours of instruction are frequently organized to study local and distant forest operations and conditions. Some tours have even taken foresters and others connected with forestry work to foreign countries. This form of practical education is used extensively by extension foresters in farm woodlot projects. A new but very significant type of education in forestry is now in progress at the C. C. C. Camps where general instruction in forestry is offered, and also special instruction pertaining to the particular forestry projects that feature the camp work. A correspondence Extension Service Course in Forestry is offered by the California State Department of Education.

VIII. PUBLIC FOREST EDUCATION

The most extensive form of forest education pertains to the selling of forestry to the public. Special efforts are being put forth by a wide range of agencies through an equally wide range of channels, to keep the public informed adequately and properly on all phases of forestry. This type of forestry work is now usually handled under the heading of "Information and Education." Formerly it was called "Public Relations," "Information," "Education," "Education and Publicity," "Publicity" or "Propaganda."

Because of an enormous increase in public interest in forestry, facilities for public education in forestry have been greatly extended and improved. They range all the way from the free distribution of blotters, calendars, rulers and book covers with forestry messages upon them, the preparation and distribution of news releases, articles, pamphlets, bulletins and books, to the giving of talks and lectures, the showing of pictures, slides and movies, and personal contacts with individuals in the field of journalism, the radio and other opinion-forming agencies. It is noteworthy that in several states, among them Florida and Wisconsin, the teaching of forestry and conservation is compulsory in high schools and higher institutions of learning.

IX. FOREST EDUCATION IN OTHER COUNTRIES

Canada has four forest schools. They are located at the University of Toronto, the University of New Brunswick, the University of British Columbia, and Laval University.

For more than 100 years professional forest schools have been in operation. Most European forest schools are state supported. A few of them, such as those at Oxford and Cambridge, are a part of private institutions. It is claimed that the Tharandt Forest School

located in Saxony, Germany is the oldest forest school of academic rank in the World. It was founded by Heinrich Cotta as a private school in 1785 and became a state school in 1816. In 1929 it was combined with the Polytechnical College at Dresden. Germany has six other forest schools of collegiate rank and twelve ranger or lower-rank forest schools.

Finland, France, Italy, Sweden and Switzerland each have one forest school of collegiate grade and from one to five lower-rank forest schools. Russia has eleven forest schools. The Leningrad Institute of Forestry—one of the oldest in the World—was founded in 1803. It is now called the Leningrad Forest Academy. In China, a four-year course in forestry is offered at the College of Agriculture at Nanking. Japan has a highly developed system of forest education which operates at three levels. There are four higher forest schools that offer courses leading to the Master's degree. Opportunity is also given for advanced work for the doctorate. The average age of students entering these schools is twenty-two years. In addition Japan has ten schools offering forestry courses leading to the Bachelor of Forestry degree and three secondary or ranger forest schools.

X. TRENDS IN FOREST EDUCATION

Forest education in the United States has been marching forward for more than forty years, but it is still in the pioneering stage of development. It has a background of meritorous achievement and a foreground of promising possibilities. Within this rapidly changing picture of forest education a number of significant trends are discernible. Among these are:

1. An extremely rapid increase in enrollment at professional forest schools in recent years.

2. The beginning of a decrease in enrollment started in the lower classes of forest schools in 1936-37. This will continue. At least a temporary peak of enrollment has been reached. There is a shortage of placement opportunities.

3. The base of forest education is broadening.

4. The period of academic training is lengthening.

5. A critical appraisal of instruction is in progress. Emphasis is shifting from quantitative to qualitative education. Educational standards are being adopted and advanced.

6. Enrollment is beginning to be limited to the number of students that can be given proper education. Selective admission is being used more widely.

7. Students of real ability and fitness for forestry will continue to be placed in promising positions.

8. The main objectives and activities of forest schools in the United States will continue to be three-fold, namely:

1. The training of men
2. The advancement of knowledge
3. The study of problems

QUESTIONS

1. Discuss the beginning of forest education in the United States.
2. What different kinds of forest education are generally recognized?
3. Discuss the development of professional forest education in the United States.
4. Discuss recent trends in forest school enrollment.
5. What are the principal subjects of instruction at forest schools?
6. What is the usual length of a professional course in forestry? Should it be extended?
7. What degrees are usually granted by forest schools?
8. Why is field work necessary in forest education?
9. In addition to complete professional courses, what other types of forest education are offered by institutions of collegiate rank?
10. What is meant by semi-professional or vocational forest education?
11. What types of special education in forestry are now offered in the United States?
12. What is meant by public forest education? What are some of the common devices used by different agencies in public forest education?
13. Compare forest education in the United States with that of other countries.
14. Discuss significant current trends in forest education.

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CHAPTER XXVI

FIELDS OF EMPLOYMENT AND TYPES OF WORK IN FORESTRY

I. AGENCIES EMPLOYING FORESTERS

Since 1900, when the first professionally trained forester was graduated from an American forest school, more than 8,500 foresters have completed their school training. Of this total more than 80% are engaged in forestry or in some closely related fields of conservation. The forest schools of our country have a total enrollment of approximately 6,000 students and are conferring degrees at the rate of 800 to 1,000 a year. For additional information on forest education see Chapter XXV.

More than three-fourths of all foresters employed in the United States are in the service of five major agencies, namely (1) The United States Forest Service, (2) Federal Agencies other than the Forest Service, (3) State Forest Services, (4) Forest Industries, and (5) Educational Institutions. The principal federal agencies employing foresters other than the Forest Service are the National Park Service, the Indian Forest Service, the General Land Office, the Biological Survey, the Soil Conservation Service, the Bureau of Entomology and Plant Quarantine, the Extension Service, and the Income Tax units of the Treasury departments. Among other agencies employing foresters are states, counties, cities, forestry and trade associations, private estates, forest nurseries, tree and landscape organizations, and foreign countries.

II. FIELDS OF EMPLOYMENT

Forestry has been broadening to such an extent and its fields of activities have become so diversified that it would make a very long list to enumerate all the different types of work within its wide scope. It is possible, however, to group the major line of employment under the following representative general headings, and

opposite each is given the percentage of foresters engaged in them in 1931, who were graduated from 1926 to 1929:

Field of Employment	*Per Cent**
Forest Administration and Management	50.7
Forest Utilization	19.3
Forest Education	3.7
Forest Research (federal, state and private)	9.6
Associations (forestry and trade)	1.3
Arboriculture and municipal forestry	8.7
Graduate study	6.7
	100.0

Since 1933 the per cent in each group has been changed considerably because of Emergency Conservation Work, and other special developments in forestry.

III. TYPES OF FORESTRY WORK

Before the emergency forestry programs got under way in 1933 about one-half of all the foresters in the United States were employed in the general field of forest administration and management. Since then the number engaged in this type of work has increased considerably. More recently there has been a considerable decrease in this general line of work. The type of forestry work often varies with the agency in charge of it, and the stage of development that has been reached. In the initial stages of forest development the work programs usually differ greatly from those in use by agencies that have advanced their programs considerably.

A. National Forestry Work

The National forests cover a total net area of approximately 175,000,000 acres—21,342,300 acres in Alaska, about 134,000,000 acres in the public-land states west of the Mississippi river, and the remainder in eastern, southern, and lake states. At present the acreage is increasing rapidly in the latter group through extensive purchases under the *Weeks Law.*

The work of the U. S. Forest Service can be grouped under three general headings:

1. Administration, Protection and Development of National Forests.

2. Research or Technical Investigation.

3. Public Relations or Extension Work, including cooperation with the states and private owners in extending forestry knowledge and furthering better forestry practices.

* From *Forest Education* by Graves and Guise.

These three general types of forestry work can be broken down further into the following major group activities:

1. *General Administrative Work.* This includes the recruiting and management of personnel, procuring funds, providing equipment, determining policies, making plans, reviewing practices and enforcing laws, rules and regulations. A relatively small percentage of the total personnel is required for this type of work. The higher ranking positions are included in this group.

2. *Forest Protection Work.* This includes protection against forest fires, insects, fungi and other destructive agents. Among the more specific lines of protection work are fire detection from towers, forest patrolling, fighting fires, appraising fire damage, controlling insect infestations and tree diseases, maintaining air patrols, and use of the radio in fire control work. A relatively large percentage of the personnel is engaged in this type of forest work.

3. *Timber Management Work.* This includes many different kinds of work and concerns a large percentage of the forestry personnel. It embraces such activities as mapping forest areas, making timber sales, cruising timber, inspecting logging operations, determining proper cutting methods, issuing permits, leasing minerals, and the acquiring, selling and exchange of land. Among the principal forest management activities is the preparation of plans aiming to establish and maintain a sustained yield of forest resources.

4. *Range Management Work.*

5. *Wildlife Management Work.*

6. *Watershed Protection and Soil Conservation Work.*

7. *Recreational Management Work.*

8. *Forest Improvement and Development Work.* To make the National forests useful and to facilitate their management and administration, it is necessary to equip them with a wide range of improvements. In recent years this type of work has occupied an unusually prominent place among forestry activities.

9. *Forest Research Work.* This includes research activities in the whole field of forestry, including forest products, forest economics and range management.

10. *Forest Extension Work.*

11. *Public Relations and General Information Work.*

B. State Forestry Work

Forty states now employ foresters and a few of them employ as many as 40 or more. In some of them, particularly those with older forestry organizations owning large areas of forest land, the types of forestry work are quite similar to those of the U. S. Forest Service. They comprise such major branches of work as forest fire control, forest pest control, reforestation, recreational development, forest extension, forest research and information with their many subordinate and supplementary activities. In some of the states where forestry is just beginning to receive attention, the principal lines of work concern themselves with the study of the forest situation, the development of a forest policy, cooperating with private forest landowners, and the education of the public about the needs for forestry and better forest practices. Forty-one states and Hawaii are now cooperating with the federal government in the prevention and control of forest fires. Forty-one states, Hawaii and Puerto Rico are moving forward with reforestation programs, which include the growing and distribution of forest tree planting stock to private planters at a very nominal cost, usually not more than the cost of production.

C. County and Municipal Forestry Work (See Chapter XIII)

D. Private Forestry Work

The private agencies carrying on forestry work may be classified in a general way as lumber companies, pulp and paper companies, water companies, utility companies, mining companies, railroad companies, recreation, hunting and fishing clubs, landscape and tree care organizations, private estates, farmers, and many other small landowners. So far the principal forestry work done by these private owners has been the protection of their properties against fires. Many of them have organized forest protective associations and have employed trained men to set up effective organizations for the detection and suppression of fires. Some companies, especially water and pulp and paper companies, have planted millions of trees on large areas. Lumber companies have also employed a considerable number of foresters in their woods operations and some are engaged in forestry activities. The naval stores industry of the South also offers employment opportunities for an increasing number of foresters. During recent years an increasing number of foresters has been engaged by the lumber industry in working out effective and practical forest practices in connection with lumbering operations.

The foresters engaged by lumber companies and other forest operating concerns must demonstrate their fitness for practical

work such as estimating timber, appraising stumpage, determining effective cutting and logging methods, estimating future growth, laying out logging roads and other systems of transportation, reducing wood waste, and participating in milling operations. There are also opportunities for foresters in the mercantile fields of the lumber business and with trade associations. A former chief forester of the United States is now secretary-manager of a Lumbermen's Association.

QUESTIONS

1. What are the principal agencies employing foresters?
2. What are the principal fields of employment of foresters? What per cent were employed in 1931 in the general field of forest administration and management? Has the percentage changed since then? Why?
3. What are the principal types of forestry work in the National forests?
4. How does state forestry work differ from federal forestry work?
5. What types of forestry work prevail with lumber companies? With pulp and paper companies? With water companies? On large estates?

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Chapter XXVII

THE LIFE AND WORK OF A FORESTER

I. THE NATURE OF A FORESTER'S WORK

Few people have a clear understanding of the life and work of a forester. To many the mere mention of the word "forest" conjures matchless miles of scenic splendor, superlative wilderness vistas, delightful associations with congenial campers, and winding trails through resin-scented pine forests. That every forester has opportunities to spend some time among such delightful and invigorating surroundings is most certainly true, but it is equally true that for the average forester such environments and experiences are relatively rare and usually of short duration. Instead, a forester often spends days and even weeks in remote regions far away from human habitations, often alone or perhaps with a few helpers. Nature with its extremes of cold and heat, drought and rain, insect pests and poisonous plants, swampy low-lands and rugged highlands, and smooth highways and terrible byways often makes the forester's work not only strenuous and hazardous, but also lonesome and tedious.

Most of the forester's work is in the out-of-doors. Only a few foresters spend most of their time indoors, and outdoor work is not always done on nice days. His work often takes him away from headquarters for prolonged periods, requires him to "rough it" and work under heavy physical strain. Forestry has no place for a weak or sickly person. To qualify as a forester one must be physically strong and possess real interest, even to the point of zest, for the kind of work that forestry comprises. A high Intelligence Quotient is not enough for a forester. He also needs a high Gumption Quotient. Rigid physical examinations are required for entrance into the national and many state forest services.

Too little is generally known about the life and work of a forester. For this and other good reasons a number of representative forestry activities and forestry positions will be considered so that one can get an idea of the general nature and scope of forestry work and the kind of personal and technical qualifications that a forester should possess.

II. THE SCOPE OF A FORESTER'S WORK

The scope of forestry work is continuously widening. There was a time when forestry concerned itself chiefly with forest protection, tree growing and a few other essential tasks, but now it reaches out along practically all lines of human endeavor, including the use of forests for recreation, the chemical utilization of wood for paper, rayon and artificial leather, the preservative treatment of wood, the conservation of wild life, the classification of land, the problems of unemployment and emergency plans for human betterment.

A forester is not a botanist, nor a dendrologist, nor an arboriculturist, nor a wood technologist, nor a wood chemist, nor a logging engineer, nor a forest ranger, nor a forest economist, nor a silviculturist, nor only a forest manager, for at times he may have all these and many other responsibilities. In the fullest sense of the word, a forester is a technically educated man who knows the forest and is capable of handling forests and utilizing their products in such a way that they will yield the largest measure of sustained human benefits.

III. ACTIVITIES OF A FORESTER

The activities of a forester are extremely varied. Throughout a year he may be called upon to do many different kinds of work. Even in a single day his tasks are usually numerous and along, and with the rapid progress of forestry they are being added to continuously. Among his principal activities are:

A. General Administration Activities

1. Determining policies and programs
2. Formulating work plans
3. Planning for cooperative work
4. Making laws, rules and regulations
5. Enforcing laws, rules and regulations
6. Reviewing practices
7. Executing contracts and agreements
8. Procuring funds
9. Recruiting, training and organizing personnel
10. Acquiring equipment and supplies

B. Forest Protection Activities

1. Preventing forest fires
2. Fighting forest fires
3. Enforcing forest fire laws
4. Building fire lanes
5. Erecting forest fire towers
6. Estimating forest fire damage
7. Controlling insect pests
8. Checking tree diseases

C. Silviculture Activities

1. Collecting forest tree seed
2. Operating forest tree nurseries
3. Planting forest trees
4. Caring for plantations
5. Improving forest stands
6. Reproducing forest stands

D. Forest Management Activities

1. Estimating standing timber
2. Marking timber for cutting
3. Making timber sales
4. Inspecting logging operations
5. Studying forest growth
6. Preparing forest working plans
7. Making forest inventories
8. Mapping forest areas
9. Leasing campsites and mineral rights
10. Issuing permits
11. Acquiring, selling and exchanging land
12. Inspecting and supervising work projects

E. Forest Engineering Activities

1. Building forest roads and trails
2. Constructing dams and bridges
3. Erecting houses, cabins and shelters
4. Constructing telephone lines
5. Surveying boundary lines
6. Locating water and power lines
7. Caring for equipment and buildings
8. Laying out building sites and designing structures

F. Forest Utilization Activities

1. Planning logging and lumbering operations
2. Felling trees and scaling logs
3. Skidding and hauling logs
4. Sawing logs into lumber
5. Grading lumber
6. Storing and seasoning lumber
7. Treating posts, poles and lumber with preservatives
8. Studying lumber markets
9. Finding new wood uses
10. Selling lumber
11. Converting wood into pulp and paper
12. Deriving byproducts from wood

G. Other Forest Activities

1. Conducting forest research
2. Carrying on forest extension work
3. Promoting forest education
4. Keeping cost accounts of forestry operations
5. Determining proper charges for forest products, uses and services
6. Promoting land use planning
7. Determining proper uses of forest land
8. Developing and supervising emergency work relief programs
9. Providing recreational facilities
10. Inspecting uses of public camp sites.
11. Studying food preferences of forest animals
12. Developing wildlife management plans.

IV. POSITIONS FOR FORESTERS

The positions in forestry are almost as varied as its activities. Many new positions have been created in connection with the

Emergency Conservation Work. Some of the regular positions and titles follow.

A. Positions in General Forest Administration and Management

The Forester (Chief Forester)
Associate Forester
Assistant Forester
Regional Forester
State Forester
Commissioner of Forestry
Forest Supervisor
District Forester
Director (Superintendent) of Forestry
Supervisor of Forest Research
Forest Inspector
District Forest Ranger
Estate Forester
County Forester
Consulting Forester
Forest Examiner
Forest Technician
Forest Nurseryman
Forest Planting Specialist
Forest Camp Superintendent
Forest Engineer
Forest Surveyor
Forest Mapper
Junior Forester
Junior Forest Range Examiner

B. Positions in Forest Utilization

Woods Superintendent
Logging Engineer
Timber Estimator
Timber Scaler
Timber Inspector
Sawmill Superintendent
Dry Kiln Engineer
Lumber Salesman
Trade Association Manager
Wood Technologist
Forest Chemist
Pulpmill Manager

C. Positions in Forest Recreation and Park Engineering

Park Superintendent
Park Naturalist
Park Guide
Landscape Engineer
Landscape Architect
Highway Forester
City Forester
Arborist

D. Positions in Forest Education, Extension and Research

Dean
Director
Professor
Lecturer
Instructor
Assistant
Extension Forester
Research Forester
Forestry Editor
Forest Economist
Forest Statistician
Silviculturist
Forest Biologist
Forest Entomologist
Forest Pathologist
Dendrologist
Wood Technologist
Timber Physicist
Curator of Woods
Forest Technician
Forest Taxation Expert
Conservationist

E. Emergency Positions

Under the Emergency Conservation Work (E C W) started in 1933, a large number of emergency positions in forestry were created, especially in connection with the C.C.C. Camps, in the U. S. Forest Service, the U. S. Park Service, the U. S. Soil Con-

servation Service, State Forest Services, State Conservation Departments and other agencies concerned with the many conservation projects now in operation. These emergency positions gave an opportunity to many foresters to resume their forestry work.

V. QUALIFICATIONS OF FORESTERS

A. Technical Training

To become a forester it is necessary to be graduated from at least a four year course in a forestry school of recognized professional standing or its equivalent. An increasing number of foresters are taking graduate work after the completion of their undergraduate training. Most forestry organizations provide additional training, particularly along practical lines, for young foresters in their service. This is called *In-service Training.*

B. Personal Qualifications

Because of the general nature of forestry work and the conditions under which it is done, the personal qualifications are usually fully as important as the technical. Graves and Guise in *Forest Education* have the following excellent statement on this subject:

"The first qualification is a personal interest in the problems of forestry. There should be an interest in the forest. This may be an intellectual interest in trees, forests and nature generally. It may be a fondness for the woods and out-of-doors, fishing and hunting, tramping and riding, and the element of adventure that is associated with the forest and wilderness. There are many, however, who are gripped by the problems of forestry, the type of pioneering involved in the development and management of forests, the challenge of hard tasks to be performed, of obstacles to be overcome, of opportunities for creative work of a constructive character. Whatever the element of interest may be, it is the factor which enables men to meet with readiness the discomforts and even dangers of forest work and tenaciously holds them to it, often in preference to opportunities for indoor work that would bring greater reward financially. This does not mean that all the work of forestry is continuously in the forest but that those who are not interested in the forest and its problems or who dislike the woods should look for some other career than forestry.

"A second qualification generally recognized as essential is adaptability. Generally this refers to the ability to adjust oneself to new situations, environments and people. It is the quality that enables one to find himself 'in place' in whatever circumstance he may be, in whatever tasks he may undertake, and with all types of men with whom he has to deal. There are a number of traits that make for adaptability, an intellectual interest in unusual situations, an objective point of view in taking things as they come, keen perception of the background of given situations, and tolerance of others whose mode of life, point of view and manner of speech may be different from one's own.

"The Forester should have a high degree of self reliance for he is constantly called upon to assume heavy responsibilities that necessitate independent decision and action. He should have initiative, intellectual and otherwise.

With this should go an active imagination. The forester is constantly meeting new problems, complex and difficult of solution. He must often evolve new ways of meeting them. He must often look far ahead, envisage possibilities he heretofore little recognized and be ready to initiate action that may not come to realization for a long period of time. Mental alertness and resourcefulness come into constant play in meeting emergencies and overcoming obstacles.

"In a great deal of the work in the general practice of forestry there is required executive ability, with all the mental and personality qualifications that are combined in this trait.

"It is often difficult if not impossible to determine whether or not a student possesses the qualifications essential to success in forestry, at least until he has been in school for some time. Frequently very important traits do not appear until a man has assumed responsibilities. This is often the case with such qualities as executive ability, self reliance and even adaptability. On the other hand, dislike of the woods-life and work, lack of interest in the problems of forestry, ineptness in handling instruments and tools, inability to relate principle to practice, or sheer incompetence in study or in the field may reveal themselves in a way to indicate that the young man is in the wrong profession."

The U. S. Forest Service in sizing up temporary employees for possibly permanent employment stresses the qualities of personality, reaction to criticism, physical strength, enthusiasm, honesty, courage, ability to work with others and powers of observation.

C. Examinations

All permanent positions of the U. S. Forest Service and other federal forestry agencies are in the Classified Civil Service, which requires the successful passing of an examination to qualify for the original appointment. The different states are also depending more and more for entrance into their forest services on entrance through competitive examinations. Most of the technical positions in the U. S. Forest Service are filled through the Junior Forester examination, conducted by the Civil Service Commission. Competitive examinations are held from time to time to fill such entering positions as Forest Ranger, Forest Range Examiner and Technician. After one holds a permanent position in the U. S. Forest Service advancement usually comes by promotion without further examination.

VI. THE REMUNERATION OF FORESTERS

The salary of foresters varies widely as in all other professions. Since most foresters are in federal, state or other public or semi-public employment, it is possible to have rather accurate information about their salaries.

Salaries in the U. S. Forest Service are approximately as follows:

Position	*Annual Salary*
Forest Guard (Temporary)	$ 900
Assistant Forest Ranger	1,620—1,980
Forest Ranger	1,800—2,160
Senior Forest Ranger	2,000—2,600
Junior Forester	2,000—2,600
District Forest Ranger	2,300—3,200
Assistant Forest Supervisor	3,200—3,800
Forest Supervisor	3,200—4,600
Regional Forester	6,000—6,500
Chief Forester	8,000—9,000

The salaries of foresters employed by states average about the same or somewhat lower than in the federal services. Salaries of those in charge of state forestry work, usually called State Foresters, range from $3,000 to $7,000, with a few receiving higher salaries. District Foresters in state forest services usually receive from $2,800 to $3,750 and their assistants receive from $1,500 to $2,500.

Salaries of foresters in private employ vary widely because of the great difference in the nature of their work and their responsibilities. As a rule, the initial salary is lower than that of government employees, but their later financial remuneration is often higher, several of whom reported earnings in excess of $15,000 per year.

QUESTIONS

1. What is the general nature of a forester's work? Why does the public not have a correct understanding of a forester's work?
2. In what directions is the scope of a forester's work broadening?
3. Name representative activities that are common in the work of a forester. Show how varied they are and why specialization is becoming more common.
4. Discuss the wide range of positions in forestry.
5. What are some of the most important technical and personal qualifications of a forester?
6. Is it necessary to take and pass examinations to enter forestry services?
7. What is the general salary scale of foresters?

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CHAPTER XXVIII

WORK OPPORTUNITIES IN FORESTRY

I. NATURE OF FORESTRY WORK

Most forestry work is done in the out-of-doors and by persons who have not had a technical training in forestry. Some of the work is delightful and easy, but most of it is hard and rough. Above all else the forest worker needs a sound body, for he works in all kinds of weather, under a wide range of conditions, and at an equally wide range of jobs. Most forest workers are engaged in tasks such as felling trees, sawing logs, hauling timber, fighting fires, building roads, blasting rocks, planting trees, eradicating weeds, and controlling pests and a host of other similar tasks. Practically all of these tasks are done in the woods where Nature as elsewhere has her extremes of heat and cold, dust and rain, mountains and swamps, and brilliant butterflies and biting bugs. While forestry work has its full share of hardships, drudgery, and routine, it also embodies a liberal measure of appeal, interest, and reward. This is why so many men are drawn to it and remain with it.

Most forestry work is done by men. Only a few forestry tasks are suitable for women and children. Locally women and children work in forest tree nurseries and help plant forest trees. Occasionally women act as observers at fire towers, assist in recreational work, and of course do a lot of clerical and other office work. In Europe women do much more forestry work than in this country.

II. KINDS OF FORESTRY WORK

In all, the permanent force employed by the U. S. Forest Service now numbers approximately 4,006. Some state forest services regularly employ 200 to 400 persons. Only a small proportion of the entire personnel does administrative work. The higher ranking administrative positions are relatively few in number. By far the largest number are at present engaged in protection and development work. Each year more than 4,000 forest guards are temporarily employed by the U. S. Forest Service alone. Thousands of laborers (skilled and unskilled) with their foremen work annually in fighting forest fires, planting trees, constructing roads and trails, maintaining telephone lines, controlling tree insects and eradicating tree diseases. As many as 3,000 fire fighters are occasionally at work on a single forest fire, and it is not unusual for several hundred men to be at

work on a tree planting job. At no time since the spring of 1933 have fewer than 125,000 people been employed in the national forests for all kinds of work; at times this number has reached 250,000.

In addition to the field workers in forestry, a large number of office workers are required. In the offices of Forest Supervisors and District Foresters are clerks, typists, stenographers and bookkeepers. In the larger administrative offices there are a large number of executive secretaries, accountants, auditors, draftsmen, photographers, stenographers, typists, bookkeepers, store-keepers, clerks, and messengers. All these, and many more different kinds of workers are needed to keep forestry going, and if it is to continue to move forward and meet its larger responsibilities many more must be added.

III. TRAINING FOR FORESTRY WORK

A. Special Schools of Instruction

More and more special training is being required in forestry work. To plant a tree successfully, to fell a tree properly, to handle fire fighting equipment efficiently, to thin a forest stand correctly, and to cooperate with the public effectively requires more than the skills and abilities of the average unskilled worker. Each year the field work in forestry is becoming more and more mechanized. This is creating a need for more skilled workers with special training, such as mechanics, operators and engineers. National and State Forest Services now conduct many different kinds of schools of instruction. Among these are training schools for forest inspectors, forest wardens, forest mechanics, road equipment operators, tree planting foremen, nurserymen, forest fire dispatchers and radio engineers.

B. Training in Service

Training within the service is becoming an established practice in most progressive forestry organizations. One of the most essential fields of training in public forestry is in public administration and public relations. First class men are needed to do high class work, but they cannot do this unless they are properly trained. Most of the larger forestry organizations now give special short course training in a wide range of activities such as fire fighting, insect control, disease eradication, tree planting, road construction and maintenance, stand improvement, soil conservation, radio operation, and law enforcement.

IV. FORESTRY WORK STANDARDS

From the beginning of organized forestry in this country, high and at the same time simple and reasonably attainable standards have been set for all forestry work. As a result, there has developed

an enduring spirit of cooperation and service. To develop and maintain satisfactory work standards necessitates careful planning. Work programs and budgets must be carefully set up, and the purposes and objectives of the undertaking must be constantly reviewed. All these things are especially important in forestry in which so large a portion of the personnel is engaged only temporarily or on a part-time basis. The intermittent and seasonal distribution of forestry work necessitates a definite program of instruction on objectives and purposes if high standards of work are to be maintained.

V. FOREST AND FARM WORK

Forest and farm work can often be combined effectively. For years this combination has offered a livelihood to thousands of rural workers. More than two and one-half million farmers derive part of their cash income from the farm woodlot. And it is interesting to note that there are more acres of tree land on American farms than acres of any other crop. The forest enables the farmers to employ themselves, their help, their teams, and their equipment during winter and other inactive seasons.

The Forestry Commission of Great Britain has worked out a practical plan for the coordination of forest and farm work. After acquiring land for public forest purposes, the better quality land is set aside for agricultural use. This land is then divided into small tracts of about 10 acres each, and after the government has improved it with buildings, it is leased to settlers. Each of these lease holders is guaranteed 150 days of forest work each year. The rest of the time can be spent on the crop land raising food for his family or for sale. Under this plan a dependable supply of resident forest workers are assured, the land is put to its highest use, and a good livelihood is provided for a considerable number of workers in stable forest communities.

The State Forestry Commission of Arkansas also has inaugurated an interesting plan of combining part-time sustenance farming on a small scale with the position of forest towerman. Each towerman is required to reside at the look-out tower he operates. At each tower is a three-room house with necessary outbuildings and about ten acres of fenced land. The towermen are employed only for eight months. During the other four months they and their families work the 10 acres of land and at such other employment as they can find. This plan of employment assures the towermen a year-round livelihood and provides for the State Forestry Commission a desirable continuity of service from the towermen. Similar farm-forestry combination projects are in operation in South Carolina and a number of other states.

VI. FORESTRY WORK POSSIBILITIES

Chief Forester F. A. Silcox of U. S. Forest Service in a recent report says:

"Although they include only some 162,000,000 acres of land, the federally owned national forests furnished more than 26,000,000 man-days of work during a twelve month period in 1933-34. **** They (labor and capital) have drained forest lands in private ownership to the point where rebuilding, improving, and developing them is essential to national welfare. There is also an urgent problem in protecting, improving and developing the publicly owned national forests. They contain less than one-sixth of the total forest land in the continental United States. Yet carefully considered plans indicate the need for at least 20,000,000 man-days of work annually, for years to come, on these federally managed properties. **** All forest lands unquestionably constitute a reservoir of noncompetitive work which can go far in helping to solve immediate problems of relief, reconstruction, and rehabilitation."

The work possibility on state, municipal and private forests is equally great. The State Forester of Connecticut has estimated that 500 men could be employed profitably for six months each year on 63,000 acres of State forests. A wood-working plant in northern New England has been operating in the same locality for more than 80 years and employs about 200 persons in the protection and care of its forests of 8,000 acres and in the harvesting and manufacturing of the forest products yielded by them. Plenty of supporting information could be supplied, showing that our forests are actually and potentially a huge work reservoir.

We are surrounded by thousands of acres of woodland that are in need of cutting operations, and would be all the better because of the cutting, if done properly. We are living also in the midst of a large number of able-bodied men, many of whom are without work and without fuel, who would be willing to work in the woods. We know now that these two important problems can be solved in a way that both man and the forest will be benefited.

VII. EMPLOYMENT IN FOREST INDUSTRIES

Forestry and the lumber industry together employed about 650,000 workers in the United States in 1929. Another 650,000 were employed in wood-working plants and in the pulp and paper industry. For more than 20 years the number of persons employed in the forest and dependent industries has been decreasing. If sound plans of forest management are introduced into our forests it may be possible to stop this decrease, and it may even be possible to bring about an increase. Permanently productive forests will not only provide steady work in the protection and care of forests and the harvesting of their crops, but also in the industries dependent upon them. There is a decided advantage in stable and permanent employment.

VIII. FORESTRY WORK IN OTHER COUNTRIES

European countries, in which forestry has been in operation for several centuries, have available considerable information on employment opportunities in forestry and the industries dependent upon forests.

A. Germany

The State forests of Prussia give work to about 144,000 men and women. The majority of them work part-time, being engaged primarily in agriculture and other lines of work. The men work in the forest an average of 98 days and the women 29 days a year. Their total work is equivalent to 33,000 full-time employees or an average of one person to every 165 acres of forest land.

Heske in his recent book (1938) on German Forestry uses a full chapter for the consideration of "Employment in Forestry and Related Industries." He points out that the forest can be cut out rapidly as a mine or managed continuously as a permanent source of production and employment. For several hundred years Germany has been doing the latter, and as a result it is estimated that the equivalent of 300,000 to 350,000 persons are fully employed throughout the year in German forests. Actually the forest work is distributed among perhaps two million persons. The total volume of employment connected with the growing, utilization and marketing of forest products in Germany is estimated to be equivalent to approximately 1,500,000 persons fully employed. This corresponds to about 4½ per cent of all persons gainfully employed in the country. And it is noteworthy that this forest work is actually distributed among at least 3,000,000 persons.

B. Switzerland

The 1,700,000 acres of public forests of Switzerland give work to nearly 10,000 full-time and almost three times as many part-time employees. This is equivalent to about one full-time worker for every 100 acres. The city of Zurich owns a historic forest known as the Sihlwald. The handling of this 2,848 acres of forest requires 20,000 days of labor a year and an additional 11,440 days of labor in the wood-using industries dependent upon the forest. On the basis of 300 working days per year, this forest gives employment to an equivalent of 66 full-time men in the forest, and 38 full-time men in the dependent industries.

C. Denmark and Sweden

In Denmark, with 750,000 acres of forest land, there is one full-time woods worker for every 125 acres of forest land.

In southern Sweden, woods employment amounts to about one worker to every 400 acres, while in northern Sweden with its less productive forests and less intensive forest management there is one woods worker to every 1,400 acres of forest land.

D. England

Forest employment in England offers some interesting figures. The Thetford Forest of 25,000 acres is a relatively new forest. The work upon it at present consists chiefly of reforestation. When the area was taken over for forestry, 6 gamekeepers were employed upon it. Since planting began from 200 to 300 full-time workers have been employed. The Forest of Dean, not yet fully stocked or developed and with an area of about 20,000 acres, gives work to almost 400 men in forest and sawmill. It is estimated that when the forest is fully productive, it will furnish employment for about 700 persons. The British Forestry Commission estimates that during the planting stage of forestry about one full-time worker is needed for every 100 acres and when the forests have reached the stage of development which includes logging and other related activities, approximately one person will be needed for every 50 acres.

These European figures on employment may not be directly applicable to the United States, but they do show that employment in forestry increases rapidly with the intensity of management and that in the aggregate forestry offers healthful work opportunities for an enormous number of workers. In the United States we do not yet comprehend fully the work possibilities in well-managed forests.

IX. FORESTRY AND EMERGENCY EMPLOYMENT

Depressions continue to come from time to time. Our experience during the past few years has given abundant proof that forestry offers one of the best fields for emergency employment. This is especially true when forests are in an undeveloped, unimproved and unregulated condition as are most of those of the United States. Fortunate are the nations, the states, the cities, and the towns that can turn to their forests in periods of depression and there find plenty of healthful work for the unemployed. This is a part of the human side of forestry.

X. PERMANENT FOREST COMMUNITIES

Just as positively as community decadence has followed forest destruction—and we have thousands of examples of this in the United States—so surely will permanent forest communities arise and maintain themselves in the wake of sustained forestry efforts. To think only of the production side of forestry is not enough, for there is also a human side to this important modern undertaking. Good forestry in the long run will pay dividends not only in forest products, services, and influences, but foremost of all in stable and responsible citizenship. Permanent forests make substantial contributions to the maintenance of permanent communities. In these perma-

nent forests and wood-using centers the wood-workers and the employees of forest industries can live with their families in permanent homes instead of living in migratory camps. This permanency will go far in developing responsible citizenship in contrast to the homeless, voteless and wandering lumberjack of the past.

QUESTIONS

1. Describe the general nature of forestry work.
2. What proportion of the persons engaged in forestry work have a technical or professional training?
3. What kind of training is usually required for the non-technical workers? Where and how do they get this required training?
4. Discuss "In-service training" in forestry.
5. Why are work standards needed in forestry?
6. In what ways can forest and farm work be combined? What are the advantages of such combinations?
7. Discuss work possibilities in forestry; in wood-using industries.
8. What lessons can we learn from European countries concerning employment opportunities in forests and the dependent wood-using industries?
9. In what ways does forestry offer a good field for emergency employment?
10. What can forestry contribute to the development of permanent rural communities?

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CHAPTER XXIX

FOREST ADMINISTRATION

I. THE NATURE AND SCOPE OF FOREST ADMINISTRATION

Wherever forestry is practiced some form of forest administration is present. Forest administration sets the goals and provides the direction for the whole forestry enterprise. It evaluates the aims and purposes of forestry, formulates forest policies and plans, develops forest programs and projects, and reviews forest practices and procedures. Foremost among its responsibilities is the providing of a competent personnel and the operation of an efficient forestry machine. It also concerns itself with the procuring of funds, the controlling of expenditures, the acquisition of land, the development of improvements, the inspection of operations, the formulation of rules, and the enforcement of laws.

Forest administration pertains primarily to the business aspects of forestry. It deals chiefly with men, money and materials. Sometimes it is spoken of as the management of men, money and materials in the accomplishment of the purposes of forestry. It is also regarded as the application of sound business principles to the manifold activities of a forest enterprise.

Forest administration is not something separate or apart from forestry. It's neither an end nor an entity in itself. Instead, it is an integral part of forestry, and functioning at its best when fully and effectively coordinated with all other branches of forestry. Its field is often as broad as that of forestry itself. No part of the field of forestry is beyond the scope of forestry administration. With the field of forestry, the field of forest administration has been extended greatly in recent years. It aims to help develop forestry along an ever-widening front.

II. PRINCIPAL DIVISIONS OF FOREST ADMINISTRATION

The following general divisions of forest administration are recognized:

1. General administration
2. Personnel administration
3. Financial administration
4. Property administration
5. Organization for administration

III. THE RELATIONSHIPS OF FOREST ADMINISTRATION

Forest administration has many relationships, both within and without the field of forestry. Its activities extend throughout the entire field of forestry and at times far beyond its borders.

A. Relationships Within the Field of Forestry

Forest administration is related to all branches of forestry, but its relationship to some of them is especially close. Among these are: forest management, forest organization (regulation), forest finance, forest accounting and reporting, forest economics, forest policy and forest law. Forest administration gives effect to forest law. Forest law is the formal expression of forest policy. Forest policy is the embodiment of forest purposes and all of these find practical expression in forest practices.

B. Relationships Beyond the Field of Forestry

Forest administration has many relationships outside the field of forestry. First of all it has an intimate relationship with government itself, also with legislative bodies, the courts, and with the public. It also has many operative contacts with other government units, such as health, highways, welfare, agriculture, properties and supplies, and especially close are its functional relationships with other branches of conservation, such as lands, soils, parks, waters, fish and game. It is also developing a closer relationship with such subjects as pubic administration, public personnel administration, public finance and business administration.

Its diversified administrative relationships in this country and abroad can be understood in part from the following official titles:

1. Forests and Lands—a division in the Conservation Department of New York.
2. Forests and Waters—a major state department in Pennsylvania.
3. Forestry and Recreation—a major state department in New Hampshire.
4. Parks and Forests—a commission in Connecticut.
5. Forestry, Fish and Game—a commission in Kansas.
6. Ministry of Agriculture and Forestry—Italy.
7. Ministry of Forestry and Mining—Jugoslavia.
8. Ministry of Afforestation, Woods and Forests—South Australia.

IV. PRINCIPAL AGENCIES OF FOREST ADMINISTRATION

An increasing number of agencies are active in some form of forest administration. A considerable number of new agencies were added during the past decade. The principal agencies now active are:

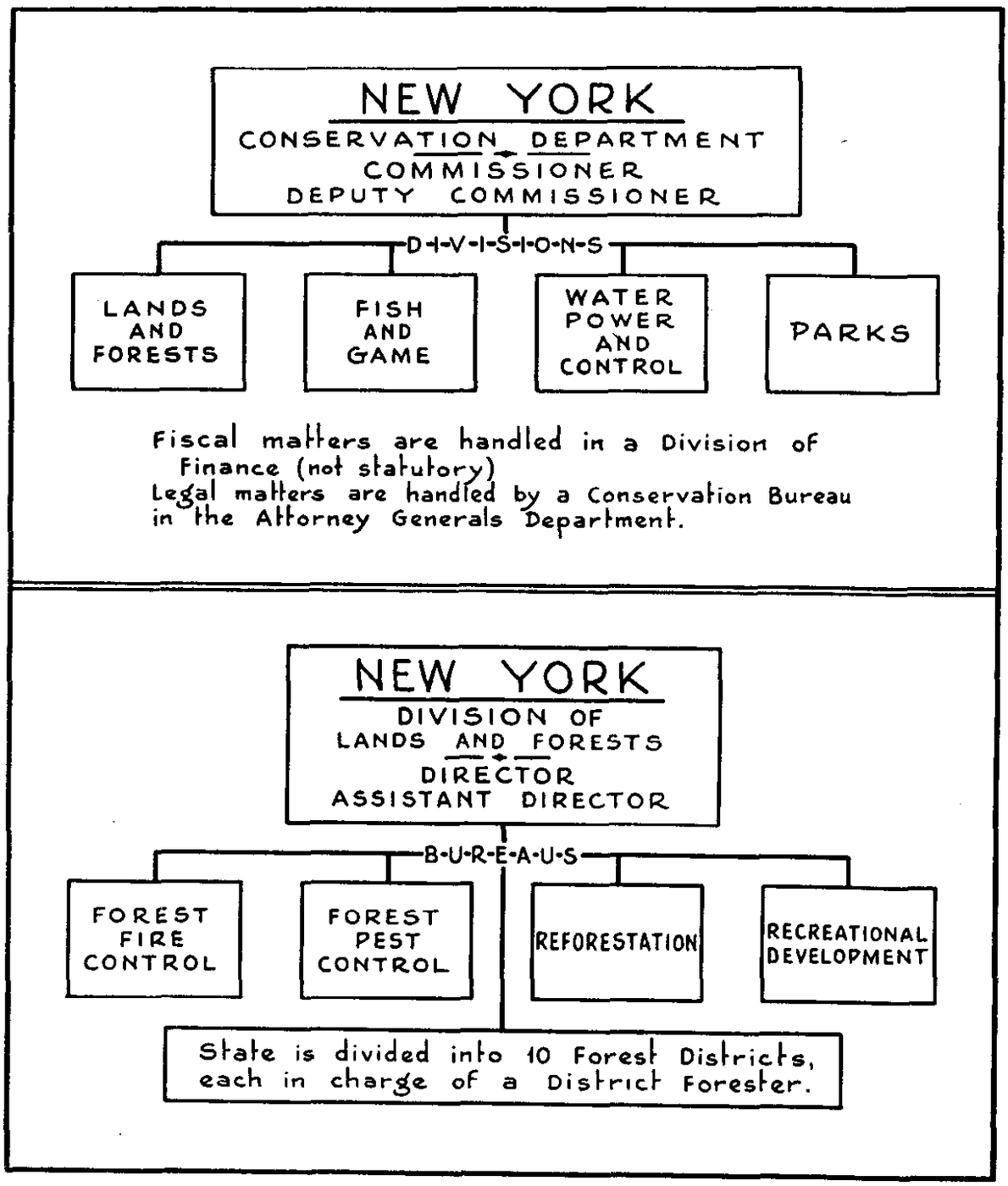

Fig. 39. Administrative Organization of Forestry and Conservation Work in New York State.

A. Federal (National) Forestry Agencies

1. The Forest Service.
2. The Soil Conservation Service.
3. The Biological Survey.
4. The Extension Service.
5. The Bureau of Entomology and Plant Quarantine.
6. The Farm Security Administration.
7. The National Park Service.
8. The Indian Forest Service.
9. The General Land Office.

10. The Tennessee Valley Authority.
11. The Prairie States Forestry Project.
12. Emergency Conservation Work.

Other federal agencies concerned directly or indirectly with forest administration are: The Census Bureau, the Internal Revenue Bureau, the Bureau of Public Roads, the Bureau of Land Economics and the Federal Trade Commission. (For more details as to these federal forestry agencies, refer to Chapters X an XI.)

B. State Forestry Agencies

Forty-two states now have administrative setups for forestry. These setups vary widely in name, make-up, and functions. Among the principal administrative units handling state forestry work are:

1. Departments of Conservation—13 states.
2. Departments of Conservation and Development—5 states.
3. Department of Agriculture and Conservation—1 state.
4. Departments of Natural Resources—2 states.
5. Department of Forest and Waters—1 state.
6. Departments of Forestry—14 states.

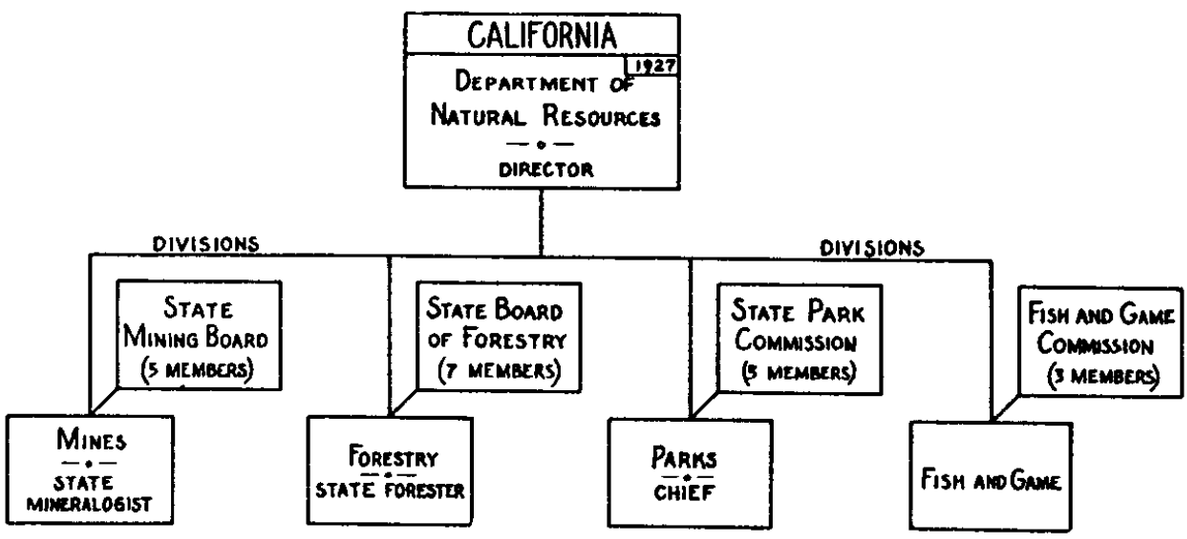

Fig. 40. In California Forestry is Handled in a Department of Natural Resources.

In three states forestry is handled by state land commissioners, and three other states have rather special administrative setups. In most of the states, a state forestry board or commission or a state conservation board or commission is a part of the forestry organization. In a few states, these boards are administrative in nature, but in most of them they are primarily advisory. (For more details about state forestry, refer to Chapter XII.)

ORGANIZATION OF MICHIGAN DEPARTMENT OF CONSERVATION

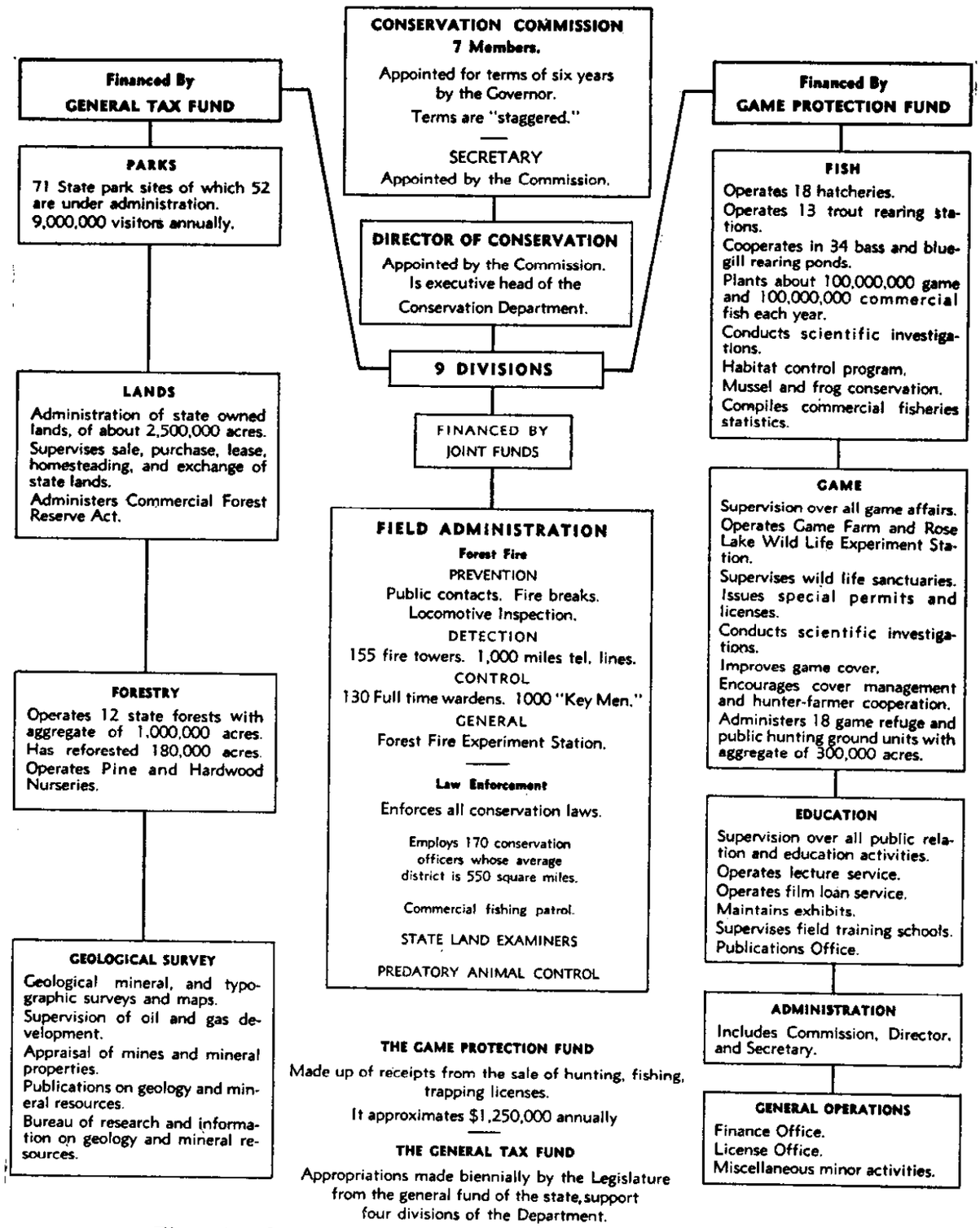

Fig. 41. Organization of Michigan Conservation Department.

C. County, Community and City Forestry Agencies

In counties the jurisdiction over forestry matters is usually vested in a Board of County Commissioners, or a Board of Supervisors. In cities forestry matters are usually handled by the City Council as a whole, or by the Bureau of Waters, Bureau of Parks, Bureau of Recreation, or the Bureau of Welfare.

D. Semi-Public Forestry Agencies

1. Educational institutions. (Most professional forest schools in the United States are public forestry agencies.)
2. Churches.
3. Associations.
4. Cooperatives.

(For more details refer to Chapter XIII).

E. Private Forestry Agencies

Most of the commercial forests of the United States are privately owned. Almost 127,000,000 acres of these commercial forests are in farm woodlands. Whatever forestry measures are applied to these areas, are carried out by the farmers themselves, often under the direction of federal and state extension foresters. Some farm woodlands are beginning to show the results of good forest practices.

Forestry is also practiced on a large number of estates and homeground properties. The President's forest at Hyde Park, New York, the Jacob Nolde Estate near Reading, Pennsylvania, and the T. C. Luther Forest Preserve near Saratoga, New York, are examples of constructive forestry achievements by individuals.

By far the largest aggregate area of privately owned forest land comes under the general heading of industrial ownership, that is, forests owned and administered by industrial organizations or corporations. They own well over one-half, and by far the best half, of the commercial forest areas of this country. They can be grouped under:

1. Lumber companies.
2. Pulp and paper companies.
3. Water and utility companies.
4. Mining companies.
5. Railroad companies.
6. Manufacturing companies.

Some of these companies have separate forestry units in their organization. Others combine forestry with some other closely related activity. (For more details, refer to Chapter XIII.)

V. GENERAL ADMINISTRATION

Every forestry organization has a certain amount of general office work to do, including stenography, typing, bookkeeping, accounting, auditing, filing, procuring, recording and reporting. These and other related activities are sometimes grouped under the general heading of General Administration. This work is usually closely associated with the office of the chief administrative officer. In smaller forestry setups the entire personnel required to do this work may comprise only a secretary and a few clerks while the larger organizations require many employees of decidedly different training

and experience to do this general type of work. The title of the person in charge of these general administration activities may be Chief Clerk, Executive Secretary, Executive Assistant, or Administrative Assistant.

In the State Conservation Department of Wisconsin these general administrative activities include stenographic and clerical services, and sections of license and confiscation, claims and permits, filing, information, and mail and supplies. On the Allegheny National Forest, located in northwestern Pennsylvania, the Executive Assistant to the Forest Supervisor functions through the following four major lines:

1. *Accounting*	2. *Property, Equipment and Supplies*	3. *General Clerical*	4. *Stenographic*
Audits, Reports, Receipts	Procurement	Communication	Stenography
Vouchers	Warehouse	Messenger service, mail, files, library, general records, general reports	General Typing
Payrolls, Appointments	Property Records		Duplicating
Bookkeeping			

VI. PERSONNEL ADMINISTRATION

Personnel administration is an important division of forest administration. It is becoming increasingly important with the rapid increase of office and field personnel required to carry on both the regular and emergency work. Personnel administration in forestry can be considered under the following main headings:

1. The recruiting and examining of personnel.
2. The classification of personnel.
3. The training of personnel.
4. The promotion and transfer of personnel.
5. The remuneration of personnel.
6. The disciplining and dismissal of personnel.
7. The retirement of personnel.
8. The organization of personnel.
9. The morale of personnel.
10. The welfare of personnel.

All of these personnel activities are becoming more and more important in both public and private forestry organizations. Numerous books, bulletins, articles and special treatises on personnel administration have appeared during the past decade. In the Washington office of the U. S. Forest Service a separate division of Personnel Management is now functioning, and in several regional offices Assistant Regional foresters have been placed in charge of personnel management.

The personnel work may range all the way from determining policies to settling petty personal differences. Whatever their nature and however trivial they may appear to be, personal problems are

among the most important that confront any forest administrator. Above all else a forest admnistrator must be a man of parts. At one and the same time he may be a policy maker, a goal setter, a trainer, a technician, a critic, a harmonizer, a coordinator, and a leader.

Personnel administration has been defined as the planning, supervision, direction and coordination of those units of an organization which contribute to realizing its defined ends with a minimum of human effort and friction, with an animating spirit of cooperation, and with proper regard for the genuine well-being of all its members. With each forward step that forestry takes, personnel administration becomes increasingly important. It is just at the threshold of worthful achievements.

VII. FINANCIAL ADMINISTRATION

Financial administration is a comparatively recent development in American forestry. In fact, it is still non-existant in quite a few forestry organizations, while a few have developed a highly efficient plan of fiscal administration. In the Washington office of the U. S. Forest Service is a separate administrative Division of Fiscal Control. It concerns itself chiefly with cost accounting, fund accounting, property accounting, fiscal statistics, field audits, voucher examinations, claims, relief bills and compensation from injury. In another administrative unit special consideration is given to finance management. In each of the ten regional offices of the Federal Forest Service there are special setups to handle finance and accounts, budget matters and allotment controls.

A considerable number of states have already set up separate administrative units in their conservation and forestry departments to handle financial matters. In the State Department of Conservation in Wisconsin there is a Division of Finance in charge of a Comptroller. The Conservation Department of New York has a Division of Finance in charge of a Conservation Finance Officer. Within the Department of Forests and Waters in Pennsylvania is a Section of Accounts.

Among the important responsibilities of a modern forest administrator is the providing and budgeting of necessary monies for a wide range of activities. They require familiarity with the meaning and operation of funds, appropriations, budgets and allotments. An appropriation is a grant of money made by a legislative body to a governmental agency authorizing the expenditure of government funds in carrying on its functions. There are general appropriations, special appropriations, specific appropriations, lump sum appropriations, lapsing appropriations, continuing appropriations, deficiency appropriations, supplementary appropriations, and emergency appropriations.

When appropriated monies become available they are usually budgeted and then allotted for specific purposes. A budget is a balance sheet of estimated revenues and expenditures designed for financing a business, a program or a project for a specified period. Two kinds of budgets are sometimes recognized, namely, income budgets and expenditure budgets. An allotment is that part of an appropriation or fund set aside by executive action for a specific purpose and can be modified without legislative action. An appropriation, as a rule, cannot be modified without legislative action. Inadequate appropriations can be added to by supplementary and deficiency appropriations.

In recent years there has been a strong trend toward setting up a stronger and more effective financial administration for forestry and other branches of conservation. We are just entering an era of better financial administration in forestry.

VIII. PROPERTY ADMINISTRATION

Every administrative agency concerned with forestry has some property under its jurisdiction, and some forestry agencies are responsible for an enormous amount of property. The property may be in the form of land, wood resources, water resources, mineral resources, improvements, such as roads, trails, dams, bridges, towers, cabins, houses, garages, storage sheds, and an almost inestimable quantity of miscellaneous equipment and supplies.

Among the important administrative problems in forestry today are forest property problems. They pertain not only to land problems such as arise in land acquisition, land exchange and land sale, but also in matters of land titles, claims, classifications, uses, trespasses and developments.

To move forward with the many forestry projects that are now in operation requires an enormous amount of equipment, supplies, and materials. Special provisions must be made to procure, store, allot, and service these items of almost daily use. For this purpose special administrative units have been set up in recent years. In the Washington office of the U. S. Forest Service is a Section of Equipment and Supply, and at Oakland, California, the Forest Service maintains a large central supply depot. On individual national forests a senior clerk is usually in charge of property equipment and supplies and property procurements, and a warehouse man is custodian of the forest warehouse. A few state forestry departments have separate setups for the procurement and maintenance of equipment, supplies, and materials. In most states the required equipment, supplies and materials are procured by a central state purchasing agency. The forestry agencies, however, are usually required to make necessary provisions for their use, maintenance, protection and storage.

IX. ORGANIZATION FOR ADMINISTRATION

Administration without organization is effective only in small forestry setups. The larger the setup, the more highly organized it must be to function effectively.

There is no fixed pattern of organization for forest administration. The federal agencies engaged in forestry work have a wide range of overhead and internal organization. The range of organization is even more diversified in the forty-two states that now have administrative setups for forestry. For details of federal and state administrative organizations for forestry, refer to Chapters X, XI and XII.

X. THE IMPORTANCE OF FOREST ADMINISTRATION

The importance of forest administration varies from nation to nation, state to state, locality to locality, and from owner to owner. It also varies with the general and specific objectives of forestry organizations, the stage of their development, their size, their permanence, and nature of their administrative setup.

In the United States, forest administration is just emerging as a distinct branch of forestry, and, therefore, is just beginning to demonstrate its worth. With the addition of more forestry activities and greater services, the expansion of functions and responsibilities, the control of expenditures, the increase of receipts and the insistence on better forest practices, forest administration will continue to increase in importance.

XI. THE FUTURE OF FOREST ADMINISTRATION

The future of forest administration is unpredictable, but there are a number of significant trends that should be helpful in understanding its present place and probable future services. Among these are:

1. Forest administration is expanding rapidly. It is operating on an enlarging base. It is on the up and up.

2. It is being coordinated effectively with other branches of forestry, with other fields of conservation, and related activities beyond the field of forestry, such as public administration, government and business.

3. It is not master of its own course. It is subject to the public will and dependent upon the public for support. Its future will in a large measure be determined by public interest and public support.

4. It must foresee future needs. It must formulate plans in advance of the actual need for them. It must be inventive and purposeful.

5. The future of forest administration will depend largely upon finding and training leaders in forestry, the development of an efficient supporting personnel, the setting up and maintaining of proper objectives and the carrying out of good forest practices.

6. The future of forest administration is assured if its central theme continues to be the promotion of the general welfare, and that the general welfare has priority over individual welfare in forestry.

QUESTIONS

1. Discuss the nature and scope of forest administration.
2. What are the five principal divisions of forest administration?
3. Discuss the relationship of forest administration to other forestry subjects.
4. What are some common relationships of forest administration beyond the field of forestry?
5. List important federal agencies concerned with forestry.
6. What are the principal groups of state agencies concerned with forestry?
7. What administrative agencies usually have jurisdiction over county and municipal forestry projects?
8. Name several important semi-public forestry agencies.
9. How are private forestry enterprises usually handled?
10. Name several groups of important industrial organizations that are concerned with forestry.
11. Explain what is usually meant by the term "General Administration."
12. Discuss the growing importance of personnel administration.
13. What are some of the important headings under which personnel administration can be considered?
14. Define personnel administration.
15. Discuss the nature and scope of financial administration.
16. What is an appropriation? A budget? An allotment?
17. What different kinds of appropriations are there?
18. What does property administration include?
19. How are matters of equipment, supplies and materials usually handled by modern forestry organizations?
20. How are federal and state forestry agencies organized for administration? Give examples.
21. At what stage of development is forest administration? Explain its importance from place to place, time to time, and from owner to owner.
22. Discuss several significant trends that are now noticeable in the field of forest administration.

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Chapter XXX

FORESTRY IN OTHER COUNTRIES

Forestry varies widely throughout the world. In some countries there is not a sign of any forestry organization or activity, while in other countries intensive forest management has been practiced for several centuries and in a few of them the beginning of forestry can be traced back for more than 500 years.

While some forty different countries scattered throughout the world are carrying on some kind of forestry work, the homelands of forestry are in central Europe. In the countries that have forestry, it ranges all the way from simple set-ups and crude practices to intensive organizations and highly technical procedures. Brief descriptions of forestry in a number of representative countries of the world follow. They aim to show the wide range of forest conditions, activities and organizations throughout the world.

CHINA

China with a total forest area of about 200,000,000 acres, including Manchuria, has awakened to the importance of forestry. In 1916 a Department of Forestry was organized in the Ministry of Agriculture and Commerce. A college of Agriculture and Forestry is a unit of the University of Nanking. A large number of organizations are engaged in the raising and planting of trees. The reclamation of vast areas of devastated and deteriorated land by reforestation is one of the important parts of the Chinese forestry program.

INDIA

British India, including Burma, has a total forest area of 215,000,000 acres. About 160,000,000 acres are under government control. It is estimated that the total annual cut from all of the forests of India is about one and one-half billion cubic feet. The Indian Forest Service administers the State forests of British India. It embraces the Imperial Service, the Provincial Services and a subordinate personnel of rangers and guards. The forests of the native states are administered chiefly by a trained staff. Educational activities and research are concentrated at Dehra Dun—a world famous forestry center. The official publication of the Forest Service is *The Indian Forester.*

JAPAN

Japan with a total area of 48,000,000 acres of forest land and an additional 15,000,000 acres of wild land suitable for reforestation, is actively at work in the development of forestry. From 200,000 to 300,000 acres of land are being reforested annually. Four schools are training foresters for the higher forest service. There are also eight agricultural and forestry schools whose three year study programs lead to the degree of Bachelor of Forestry. About two-third of the forest area of Japan is owned by the State, crown, communes and the church, and the other one-third privately. Japan exports a large quantity of forest products but also imports large quantities of lumber from Manchuria, eastern Siberia, and the west coast of North America. Among the wood Japan is importing from the United States in considerable quantities is Port Orford Cedar.

GREAT BRITAIN

Not more than 3,000,000 acres remain of the extensive forests that once covered Great Britain. Less than five per cent of the total land area is in forests, and at the close of the World War 96 per cent of this area was privately owned. Since then the government has purchased considerable areas and leased other tracts for forestry purposes. In 1919 a Forestry Commission was appointed to develop a reforestation program covering the acquisition and planting of almost 2,000,000 acres. During the first decade under this program more than 200,000 acres were planted by the state and by groups of semi-public and private organizations.

Of all the European countries, the United Kingdom has the smallest percentage of its forest area under state control, less than three percent being crown lands and almost 96 per cent in private ownership. In most forests of the United Kingdom the protection of game is the main objective. In only a few forests, such as the Forest of Dean and the New Forest, is forestry of the type practiced in continental Europe in general use. Some wealthy forest land owners are handling their forest entirely for deer, hare and pheasant production.

Although the state did relatively little to promote forestry, prior to 1919, municipalities, corporations and private owners made considerable progress, especially in the development of large areas for watershed protection purposes.

At present instruction in forestry is offered at 8 colleges and universities, including Oxford, Cambridge, and Edinburgh. Several active Forestry and Arboricultural Societies are keeping the public and the profession interested in forestry. A special feature of the afforestation program is the development of small colonies of forest workers near the forest operations.

SWEDEN

Of all the European countries, Sweden, next to Finland, has the highest percentage of its land in forests. It has a total productive forest area of 57,000,000 acres. The composition of the forest is very simple, being made up chiefly of Scotch Pine, Norway Spruce and White Birch. Nature favors Sweden as a land of forests. In fact a large part of the soil cannot maintain any other kind of vegetation. About one-half of the wood cut from the forests of Sweden is exported directly or as pulp and paper. Of the wood-using industries, the lumber industry ranks first and the pulp industry comes second.

Sweden has a highly and efficiently organized forest service, which is a part of the Department of Agriculture and has complete control of all government forests, supervises or manages other public forests, and cooperates with private forest owners. Since 1903 the enforcement of forest laws has been entrusted to a commission of three in each province. For more than 100 years Sweden has had a college of forestry for the training of higher forestry personnel. It is located at the outskirts of Stockholm and was completely reorganized in 1915. Seven junior forest schools are maintained in different parts of the country for the training of the lower forestry personnel. A unique school, called the Institute of Forest Management, is operated to train men chiefly as forest sawmill operators and for logging operations. The forestry movement in Sweden is supported by the Swedish Forestry Associations and several other active organizations. Forestry has a prominent place in the public schools of Sweden. Within each county is a forest conservation board consisting of three members. The members are appointed for three years and receive no salary. They employ a county forester.

FINLAND

Finland, or Suomi as the natives call it, is a land of forests and water. It is one of the most heavily forested countries of Europe and forests are its main resource. A recent forest survey of the entire country shows that 75 per cent of the total land area is forest land. The forests (63,000,000 acres) are chiefly coniferous, pine and spruce comprising about 80 per cent and birch making up most of the remainder. There are only three important forest trees in all of Finland—Scotch Pine, Norway Spruce and White Birch. The federal government owns outright about 40 per cent of the forest land. In addition the federal government has a controlling interest in many private forest corporations, including sawmills and pulpmills. Church-owned forests total about 500,000 acres.

The Tapio Forestry Society is the central agency for promoting forestry. More than twenty agricultural cooperative societies employ

at least one forester and one or more forestry instructors. A Department of Forestry at the University of Helsinski trains technical foresters and a Forest Research Institute founded in 1917 gives attention to a wide range of forest investigations. Several schools for the training of forest rangers are in operation. The Finnish Forest Service is one of the most progressive in Europe and there is widespread appreciation of the importance of forestry throughout the country.

RUSSIA

The forest area of Russia, both European and Asiatic, is estimated as somewhat in excess of 1,500,000,000 acres of which less than one-half is accessible. In addition there are vast areas of non-agricultural lands that do not support any tree growth. Before the war the state owned nearly 70 per cent of the forest land of Russia. Now all forestry activities are nationalized. The wood cut in the forests of Russia in 1930 is estimated at 8,500,000,000 cubic feet, of which at least one-half was firewood. This was probably somewhat more than the annual growth.

Before the revolution Russia had several forest schools for the training of the higher forestry personnel and about 30 schools for the training of the lower personnel. Since the war the number of schools has increased. It is reported that Russia now has the forest school with the highest enrollment in the world. In 1930 the forest administration was removed from the Department of Agriculture and joined with the Soviet timber industry as a unit under the Supreme Economic Council, but in 1931 the forests included in "forest cultural" zones were again placed under the Department of Agriculture. While excessive forest exploitation has occurred in recent years, extensive clear-cutting is now forbidden, deforested areas are being replanted, and official orders specified that by 1935 the annual forest cut must be reduced to the annual forest growth. In parts of Russia are some excellent examples of successful shelterbelt plantings, the results of which may be helpful in developing the Plains Shelterbelt Project in the Mid-west of the United States, now called the Prairie States Forestry Project.

SWITZERLAND

There are about 2,480,000 acres of forest land in Switzerland. Of this, only about 110,000 acres (less than 5 per cent) are owned by the Cantons. About 672,000 acres (27%) are owned by private individuals. The bulk of the forest land (1,700,000 or 68 per cent) is owned by the communes. The largest area of forest land (440,000 acres) is in the Canton of Berne.

Some of the oldest examples of forestry in the world are credited to Switzerland. A special forest ordinance regulating a forest area

in the Canton of Berne dates back to 1304. The first forest working plan was made for the city forest of Zurich—the world famed Sihlwald, in 1680-1697, and as early as 1491—one year before the discovery of America—the boundary lines of this historic forest were definitely demarcated. The Sihlwald is one of the oldest examples and outstanding achievements of forestry in the world.

The annual cut of the forests of Switzerland, both public and private, is rigidly controlled. Because of the mountainous topography, the bulk of the Swiss forests are classified as protection forests, in which cutting is permitted only under the rigid supervision of foresters. In 1843 the Swiss Forestry Association was organized. A technical course in forestry has been given at the federal Polytechnic School since 1855. It covers three years of school work and one and one-half years of actual forest work. Since 1888 a Forest Experiment Institute has been in operation. It has given a strong impetus to the forestry movement and contributed greatly to placing forestry on a sound technical basis.

ITALY

The forest area of Italy is approximately 14,000,000 acres, representing less than 20 per cent of the total land area of the country and less than one-half of an acre per inhabitant. A considerable portion of the forests are in the high mountains where they are important for watershed protection purposes. The Italian forests are about two-thirds privately-owned and one-third publicly owned. Of the latter the government forests comprise less than 10 per cent, the remainder belonging to municipalities, villages, and semi-public corporations. Among the most valuable forest assets are extensive chestnut groves (about 1,000,000 acres) which supply much-needed products for the wine industry. At the age of three years the sprout chestnut forests are thinned for material for barrel hoops, at 6 to 8 years for vineyard stakes, and are cut for barrel staves at 25 to 30 years. This is one of the most profitable forestry enterprises in Europe.

For decades many of the forests of Italy have been deteriorating. A mandatory reforestation act was passed in 1910 and a comprehensive forest law was enacted in 1923. Based upon the Mussolini Law of 1928 a national plan of land utilization known popularly as "Bonifica integrale" was put in operation in 1930. It embraces all measures necessary to promote, intensify and stabilize the economic and social usefulness of land. Among these measures are protection of watersheds, reforestation and regeneration of deteriorated forests.

The control of public forests is in the hands of the Forest Militia—a semi-military organization. Foresters are trained at the

Royal Forest Institute affiliated with the University of Florence. Prior to 1912 the Royal Italian Forestry College was located at Vallombrosa, where it was founded in 1869. One of two forest ranger schools is now operated at Vallombrosa, where a forest arboretum with more than 5,000 species and varieties is maintained.

MEXICO

Recent reports set the forest acreage of Mexico at approximately 81,000,000 acres, of which more than 50 per cent is covered with rich forests and perhaps about 25,000,000 acres are stocked with inferior growth. A large proportion of both types of forest land is in the hands of national, municipal and communal governments. A considerable acreage of land is owned by mining and oil companies. The exportation of high-grade woods is an important business and there is also a large domestic consumption of wood for industrial and home uses.

For some time Mexico has had a Forest Service charged with the protection and administration of public forests but relatively little progress was made until within the past few years. In 1933 Dr. Miguel A. De Quevedo, a distinguished engineer and generally regarded as "The Father of Mexican Forestry" outlined a progressive six year forestry plan for Mexico. It was approved by the National Convention in 1934 and is a part of a broad political, economic and social plan for the nation. An outgrowth of this plan is the creation of a national Department of Forests, Game and Fish. It functions through the following forestry divisions: (1) forest management, (2) reforestation, (3) range management and fire protection, (4) forest entomology and pathology, (5) information and statistics, (6) forest instruction and investigations, (7) law and legal advice, and (8) general administration and accounts. Present plans also call for an institute of Forest Engineering, three Forest Guard Schools, and an Institute of Forest Investigations. A rapid increase in technical forest personnel is anticipated. Perhaps 200 forest engineers and 400 forest guards will be needed annually. An annual budget of $1,000,000 is recommended to carry out the enlarged forestry program.

FRANCE

The total forest area of France is 25,570,000 acres. Of this the state owns about 3,600,000 acres, the communes and public institutions almost 5,500,000 acres and private owners 16,470,000 acres (64%). A feature of French forestry is the large aggregate area of forest land held by small owners. Almost one-half of the privately owned land is owned in small tracts by 1,500,000 owners. Just before the World War there were only 79 private owners of

forest land in all of France with more than 2,500 acres. It is estimated that more than 400,000 acres were completely devastated during the war and almost an equal area suffered greatly from reck-

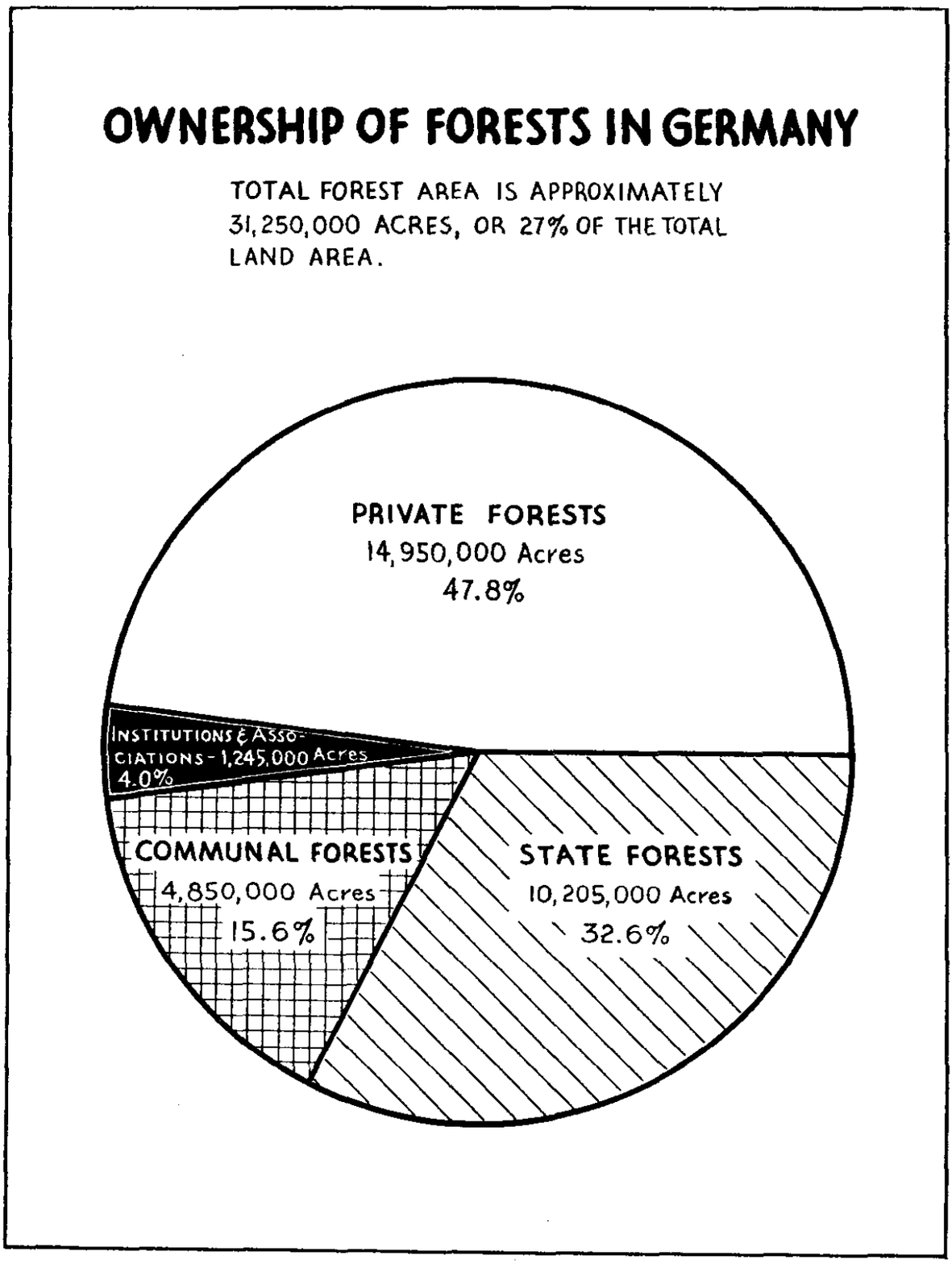

Fig. 42. Classes of Forest Ownership in Germany by Total Acreage and Percent of Total Forest Area.

less and excessive exploitation. In recent years the government has developed reforestation programs to replant the areas devastated

during the war and to overcome the loss due to supplying the allied armies with forest products.

Since the days of Colbert and the Forest Ordinance of 1669 forestry has been moving forward in France. The National Forest School is located at Nancy and a secondary forest school at Les Barres in Loiret. The French forests are administered by a Division of Waters and Forests in the Department of Agriculture. For administrative purposes the entire country is divided into 32 Conservations (Districts), each in charge of a conservator. One of the outstanding achievements of French forestry is the reforestation of the Landes region of southwestern France where several million acres have been reclaimed chiefly by planting pines. This is probably the best example of large scale reforestation in the world.

GERMANY

Before the World War Germany had about 35,000,000 acres of forest land. As a result of the war about 4,000,000 acres were lost, leaving approximately 31,000,000 acres. This represents about 27 percent of the total land area and one-half of an acre per capita. Somewhat less than one-third of the forest area belongs to the states, one-sixth to the communes, almost one-half to private owners, and the remainder to institutions and associations. It is noteworthy that in Germany practically no forest land is owned by the national government. The states formerly played an important role in German forestry. Prussia and Bavaria together contain almost 70 per cent of all the forest land of the country. Some of the best examples of municipal and communal forestry in the world have been developed in Germany. The municipal forest of Heidelberg has been in operation since 1392. The Black Forest made up of state, municipal and communal forests is famed all over the world. Forest experimental stations and forest research institutes are maintained by different states. Some of the foremost and oldest professional forest schools in the world are in Germany and a number of secondary forest schools have been in operation for a long time. In most of the private forests of Germany some form of sustained yield is in use.

A new, comprehensive national forestry law, is now (1938) being drafted. Three important national forestry laws were enacted in 1934, namely, the forest devastation law, the law of forest races, and law transferring forestry and game management to the Reich.

CANADA

About one-fourth of the total land area of Canada, or about 600,000,000 acres, is covered with forests, but of this only about 250,000,000 support a forest growth of commercial size. More than

90 per cent of the forest land is owned by the Dominion Government or the provinces. Since 1930 the crown timberlands have been under the jurisdiction of the respective provinces. Federal control is retained in almost 19,000,000 acres of National Parks and 5,000,000 acres of Indian Reservations. The federal government also maintains several forest products laboratories. All the provinces except Prince Edward Island maintain a Forest Service. In British Columbia, forestry is a branch in the Department of Lands, with a Chief Forester in charge. The different lines of forestry work are handled through divisions of management, operation, records (finance), surveys, research, trade extension and grazing. This province is divided into five forest districts each in charge of a district forester with a staff of supervisors, rangers and a temporary protection staff. The forest area in each of the five forest districts ranges from 15,000,000 to 47,000,000 acres.

Technical forestry courses are offered at the Universities of Toronto, New Brunswick, British Columbia and Laval. The Canadian Society of Forest Engineers covers the technical fields of forestry. The Canadian Forestry Association, with a membership of more than 20,000 and an official magazine *Illustrated Canadian Forests and Outdoors* is carrying on an active educational program in forestry.

Forestry on Large Private European Forest Properties

In central Europe are found a considerable number of large private forest properties ranging from several thousand to sixty or more thousand acres. The Schwartzenberg Forests in Bohemia, probably the largest privately owned forest in central Europe, aggregating 207,000 acres in area, have been under management since 1852. The Forest Estate Neschwitz of 4,150 acres in Saxony, Germany, has been in the present ownership since 1763. Count Arnim's Forest Estate with 63,900 acres of forests in Silesia has been under permanent working plans since 1860. The estate of General Baron von Keudell, head of the Prussian Forest Service in Germany and President of the Deutscher Forstverein, comprises approximately 6,400 acres, of which about 4,000 acres are in forests. This estate has been under forest management for more than 100 years. All operations in this forest area are controlled by forest management plans in charge of one forest officer and two rangers.

QUESTIONS

1. In how many different countries of the World is forestry practiced? To what extent does it vary from country to country?
2. Why does China need forestry? What progress in forestry has been made in China in recent years?

3. How are the forests of India administered? Where is the headquarters for educational and research work in forestry in India?
4. What is Japan doing to conserve and develop her forest resources?
5. Discuss forestry in Great Britain, with special reference to forest areas, game management, reforestation, rural rehabilitation and forest education.
6. How are the forests of Sweden administered? Discuss the different levels of forest education in Sweden.
7. Name the three important forest trees of Finland. Who owns the forests of Finland? How common are church forests? Discuss the work of cooperative forestry organizations?
8. Discuss the forest resources of Russia. How are they administered? What progress has been made in shelterbelt plantings?
9. Discuss forestry in Switzerland with special reference to early forest management plans, protection forests, and regulation of cutting on privately owned forests.
10. What are some of the outstanding features of forestry in Italy? Who controls the public forests? What is meant by *Bonifica integrale?*
11. Tell about the recent reorganization of forestry in Mexico.
12. Compare forestry in France and Germany. How is forest ownership in Germany distributed?
13. Discuss private estate forestry as developed in central Europe.
14. Who administers the forests of Canada? What acreage do they cover? Name the forest schools of Canada. By what means is popular education in forestry promoted in Canada?

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Chapter XXXI

SIGNIFICANT TRENDS IN FORESTRY

American forestry is a forward moving enterprise. It is moving ahead on many different fronts. In this forward movement it is possible to discern many different trends of development. Some of these trends have been active since the beginning of forestry: others are just starting to emerge. It is noteworthy, however, that out of this large conglomerate mixture of diverse trends in American forestry, a considerable number are already standing out prominently above all others. All evidence indicates that most of these significant trends will remain active for a long time, and that they will determine largely the future course of American forestry.

The background of American forestry is full of meritorious achievements. Its foreground is dotted densely with promising possibilities. Without discounting the merits of past performances and the values of past achievements, the concluding chapter of this little handbook will be devoted largely to listing and discussing briefly some of the more significant trends now active in American forestry and likely to play important roles in the fashioning of future forestry programs.

I. GREAT CHANGES IN LAND USE AND OWNERSHIP

Since the beginning of settlement of this country, land use and land ownership have been changing continuously. The boundaries of our forests and farms have at no time remained fixed. As recent as fifty to seventy-five years ago our federal government was doing an enormous land office business, consisting almost entirely of land disposal activities. Then land was transferred wholesale and retail from public to private ownership. The settlement of the mid-west and the opening of the far-west brought forth the most extensive program of public land disposal ever undertaken in any country. Gradually this powerful trend of land disposal slowed down and in time came practically to a standstill. Now the pendulum is swinging in the opposite direction. The federal government is buying back much of the land it formerly sold or gave away. Millions of acres of abandoned farmland and tax delinquent forest land are finding their way back into federal, state, county and other forms of public ownership. The present land shift is definitely away from agriculture and towards forestry. The correct solution of this problem depends upon proper land classification.

Within the forest itself there is a continuous shift in land use. On some forest areas the shift is from timber production to grazing. On other areas the shift is from grazing to water conservation or from timber production to recreation or wildlife conservation. In practically every forest region these shifts in forest use are going on continuously. Some of these changes have resulted in betterment and others in detriment. Unfortunately many land shifts in the past were based on adventurous promotion schemes, selfish propaganda, wild guesses, and unchecked enthusiasm. The present trend in land use is definitely away from guesswork towards an intelligently planned, well-directed, and publicly controlled program of land utilization. Rural zoning is becoming an established practice in progressive states. Proper land use is now a basic requirement in every sound plan of forest administration.

II. RAPID INCREASE IN PUBLIC-OWNED FORESTS

One of the most significant trends in American forestry is the rapid increase in public-owned forests, especially federal-owned forest lands. There are now more than 175,000,000 acres in the national forests alone. In 1911 the purchase of forest land by the National Forest Reservation Commission was authorized by the Weeks law. The first purchase under this law was made in 1913, when a total of 103,186 acres of forest land were acquired. Since then additional purchases have been made each year. The annual purchases during this 22 year period (1913-1934) ranged from a low of 87,589 acres in 1914 to a high of 594,965 acres in 1934. The total area of forest land purchased under this law from 1911 to 1934 is 5,126,947 acres.

During the last four years the land purchases have been increased greatly, chiefly through the development of the Emergency Conservation Work Program. The following table lists the acreage of forest land acquired under the Weeks law by the National Forest Reservation Commission in recent fiscal years:

Year	*Area Purchased (Acres)*
1935	2,082,805
1936	3,579,580
1937	3,450,202
1938	1,433,038
TOTAL	10,545,625 (Acres)

It is noteworthy that during the four fiscal years 1935-1938 more forest land was purchased than the total area acquired during the previous 24 years. And fully as significant is the fact that during this same period other federal agencies, such as the Resettlement Administration and the Biological Survey, also were acquiring large areas of forest land.

An official report of the U. S. Forest Service recommends an addition of 224,000,000 acres to the public-owned forests of the United States, 177,000,000 acres in the East, and 47,000,000 acres in the West. Of this acreage the state's share is 90,000,000 acres and that of the federal government 134,000,000 acres. Many of the states also have set up forest land purchase programs. In a few of them considerable progress has been made in the acquisition of forest land for a rather wide range of purposes. On the whole, however, most states have found it necessary to curtail, at least temporarily, their forest land purchase work while that of the federal government has forged ahead at an unprecedented rate. In 1935 the Governor of New York, on the basis of a report of the State Planning Board, recommended the development of an enlarged public domain aggregating 9,000,000 acres, or more than one-fourth the total land area of the state. Other states have outlined similar programs. There is general agreement among those who have studied the forest situation that additional large areas of forest land should go into public ownership, and it is safe to predict that the trend will continue in that direction, but perhaps not at so strong a rate as in recent years. The big question, however, is what proportion of the forest land to be purchased shall go respectively into federal, state, county, community and other forms of public ownership. In short, what public agencies shall have jurisdiction over the forest land that will be acquired in the future. The correct answer to this question is not available now. Future developments will bring forth the answer.

III. STEADY SHIFT TOWARD CENTRALIZATION

In American forestry a steady shift towards centralization of powers, influences and responsibilities is now in operation. The federal government is doing more and more in contributing greater and greater amounts of money and services towards forests activities carried on by the states, and by other public and private agencies. Likewise the states are assuming greater responsibilities and giving more assistance in forestry matters to subordinate political units, organizations and private forest land owners and operators. This strong shift towards centralization of forestry powers, influences and responsibilities is maintained in a large measure through financial grants-in-aid and other forms of cooperation and assistance. That the nation, and the states and the counties are assuming more and more responsibilities and the private forest land owners and managers less and less is an obvious fact. This trend towards greater centralization of jurisdiction in forestry matters is one of the most significant, and in some localities the most controversial, in the whole field of American forestry.

IV. CLOSER COORDINATION AND BETTER INTEGRATION OF ACTIVITIES

Each forward step in American forestry offers positive proof that it cannot function effectively by itself. Its relationship, both internal and external, are essential elements in any sound plan of administrative organization. Its relationships to health, welfare and government itself, as well as its relationships to game, fish, parks, waters, lands, minerals and other natural resources, are all highly essential to any well-rounded and efficiently organized forestry program. The present trend is definitely towards a closer coordination and better integration of forestry activities. In the 42 states that now have some form of administrative setup for forestry, there has been a strong and sustained trend toward the combining of forestry with other closely related activities. More than one-half of the states, having administrative setups for forestry, now handle their forestry work in combination with other major state activities such as wildlife, parks, waters, minerals and other natural resources, in boards, commissions or departments of conservation. For many years special efforts have been put forth also to effect a closer coordination of conservation activities in the federal government. There is now general agreement that an effective coordination and integration of forestry with other closely related governmental activities is definitely in accord with good business management and sound principles of public administration.

V. MORE AND BETTER COOPERATION

Much good has come already from cooperative efforts in forestry. The present trend is toward more and better cooperation. There is urgent need for better cooperation between federal agencies having forestry responsibilities. There are also innumerable opportunities for more and better cooperation between federal, state, and county forestry agencies, and private forest land owners and operators. Three main avenues of approach to the privately owned forest land problem suggest themselves, namely, public ownership, public regulation, and cooperative effort. There is general agreement that the latter should be given adequate and fair trial before the other two are pushed ahead too aggressively, in the belief that much good in forestry can be realized through cooperative efforts.

Cooperative forest fire protection under section 2 of the Clarke-McNary Act, and the cooperative raising of forest planting stock for use by farm woodland owners under section 4 of this Act are good examples of effective cooperation. It is noteworthy that 47 states are now cooperating in forestry with the U. S. Forest Service under the Clarke-McNary law, and all present development trends point definitely to a fuller and more effective cooperation in the future.

Among the cooperative opportunities recently made available, or now being made available, are special cooperative provisions in recent federal legislation, such as the Cooperative Farm Forestry Law, Title III of the Bankshead-Jones Law, Fulmer Forest Law, Soil Conservation District Laws, Cooperative Sustained Yield Laws, and Cooperative Sustained Yield Projects.

These cooperative efforts in forestry are not limited to the federal government. States are cooperating with counties, communities, and private organization and individuals in the setting up and development of effective forestry programs and practices. During the past decade several groups of neighboring states have developed effective cooperative compacts or agreements covering important forestry activities common to these states. The growing importance of cooperative effort in state forestry is recognized in the Conservation Department of Wisconsin in which a major administrative division called "Cooperative Forestry" has been functioning for some time. An increasing number of private forest land owners and operators are organizing cooperative associations for their mutual benefit. Among these forest cooperatives are the Otsego Forest Products Association and the Tioga County Cooperative Project of New York, the Forest Products Association in New Hampshire, the Vermont Maple Products Cooperative in Vermont, and the Northland Yuletide Greens Cooperative in Wisconsin.

No agency, whether it be federal, state or private can alone develop an effective forestry program. At times the federal government has attempted to "go it alone" in forestry matters. Most states and many private forest land owners have erred in attempting to go forward with forestry projects by themselves. The past offers plenty of evidence of the weakness of such selfish plans. On the other hand abundant proof is available in favor of well-balanced cooperative effort. The present widespread trend towards greater and better cooperative effort in forestry is among the most significant trends in the whole field of American forestry. We are now at the threshold of an active period of more and better cooperation in forestry matters of all kinds. This enlarged and improved program of cooperation deserves the active support of everybody interested in the development of forestry along a broad and purposeful front.

VI. IMPROVED FOREST PRACTICES

That improved forest practices are called for in practically every phase of forestry work is now recognized by all agencies engaged in forestry work. Consequently special efforts are being put forth in all parts of the United States to determine and put in use better forest practices. It is becoming more and more apparent that that forestry is best which works best in the woods. Special handbooks of forest practice are now being developed in all parts of our

country covering a wide range of forestry activities. In 1934 the West Coast Lumbermen's Association issued a "Handbook of Forest Practice," in which consideration is given to such practical problems as providing a proper seed supply, provisions for restocking land after different kinds of cutting, different methods of selective cutting, proper development of young and immature growth, effective protection during and immediately following logging, and the all important practice of sustained yield management. This handbook has been revised several times since its first appearance. The U. S. Forest Service and several states have issued numerous reports and handbooks on approved forest practices. Many private and public forestry organizations are giving special consideration to this important subject of developing better forest practices along such lines as practical cutting methods, effective reproduction methods, better forest tree seed collection, quality planting stock production, the proper keeping of accounts and records, the development of effective systems of transportation and communication and above all else a closer coordination and a more effective integration of the greatly diversified activities and practices so highly essential in every forestry enterprise.

Not much more than a bare start has been made in the development and application of effective and economical forest practices. In many respects this important aspect of forest management has lagged far behind other developments, and yet no forest problem is more urgently in need of practical solution. It is significant, however, that slowly but surely improved forest practices are finding their way into the woods and displacing the wasteful and uncertain practices of the past. The trend in forest practices is definitely on the up and up, and it appears as if the next decade will bring forth many improved forest practices.

VII. SUSTAINED YIELD MANAGEMENT

Some progress has been made in the direction of sustained yield management in forestry. Under the Lumber Code of 1933 the lumber industry committed itself to stop the practice of "cut-out-and-get-out" and go on a sustained yield basis of operation. Its definite purpose as expressed in Article 1 of the code was "to conserve forest resources and bring about sustained yield from the forests." This plan of action was of short duration for early in 1935 the whole National Industrial Recovery Act, of which the Lumber Code was a part, was declared unconstitutional by the U. S. Supreme Court. Since then the lumber industry has been attempting to move forward and apply the idea of sustained yield management, which has been a basic principle in national and state forest administration from the beginning of these public forestry efforts.

The sustained yield principle is gradually finding its way into federal forestry legislation. The law enacted August 28, 1937 relating to the revested Oregon and California Railroad and reconveyed Coos Bay Wagon Road grant land specifies that these lands shall be managed for permanent forest production and that "the timber thereon shall be sold, cut and removed in conformity with the principle of sustained yield for the purpose of providing a permanent source of timber supply, protecting watersheds, regulating streamflow, and contributing to the economic stability of local communities and industries, and providing recreational facilities." This law also provides that "If the Secretary of the Interior determines such action will facilitate sustained-yield management, he may subdivide such revested lands into sustained yield units." The most progressive features of this Act of August 28, 1937 are authorizations and prescriptions for cooperative planning in forestry. The Act authorizes the Secretary of the Interior to make cooperative agreements with other federal and state agencies and with private owners and operators for the coordinated administration of forest units comprising parts of the revested and reconveyed lands in conjunction with other public forest lands and lands in private ownership, if such action will facilitate sustained-yield management. In another section of this Act authorization is given the Secretary of the Interior to cooperate with the Oregon State Board of Forestry, private forest owners and operators and other persons and agencies in formulating forest plans and practices, and also to cooperate with federal, state, county and private agencies and individuals in forest-fire-protection work. Planning for a wide range of diverse forest activities is an outstanding feature of this Act, which for the first time in American forestry gives specific legal authorization for the creation and development of cooperative sustained yield units, comprising forest lands under the jurisdiction of federal and state agencies, and private forest owners and operators. This is an entirely new kind of cooperative undertaking in American forestry. It operates at the very apex of progressive forest administration, and if this new plan of cooperative sustained yield forest management is developed successfully, it will provide a new approach to the practice of forestry in America. That there is a definite and sustained trend towards sustained yield forest management in America is not only formally expressed in law, but also freely included in rules and reguations and what is most significant of all is the fact that it is gradually finding its way into forest practices.

VIII. BETTER PERSONNEL TRAINING

During the early stages of American forestry practically all forest workers started without special training and often without actual experience in forestry work. Prior to 1898 no professional

training in forestry was offered anywhere in this country. Now more than 20 accredited forest schools offer a wide range of training, covering not only the field of general forestry but also training in such specialized fields as forest economics, forest pathology, forest entomology, forest chemistry, range management, and wildlife management.

The training of forestry personnel is not limited to professional and subprofessional training prior to entering upon a position, but also includes training after accepting a position. The latter type of training is rather new and is frequently called post-entry training. Perhaps no form of training has contributed more to the improvement of forestry personnel in recent years than these special post-entry training courses now offered by many progressive forestry organizations. The U. S. Forest Service, other federal forestry agencies, and many state forest services now offer special training courses covering a wide range of activities. Special divisions of personnel management are now a regular part of the administrative setup of many of the larger forestry organizations. A rapidly expanding program of apprenticeship training is gradually being worked out as a regular requirement of personnel management in an increasing number of forestry agencies.

Considerable credit for the improvement of personnel must also be given to the extension of the merit system. In the federal and state services in which the merit system is now established there has been a marked improvement in the quality of personnel services. Unfortunately, the progress in personnel improvement is by no means as great as it should be, but in spite of strong and persistent retarding factors, the personnel standards in forestry are moving upward, and if this upward trend continues the forestry personnel of the future will be greatly superior to that of the present. And there is no surer way to improve forestry than through the improvement of personnel.

IX. BETTER FISCAL ADMINISTRATION

During the early stages of forestry fiscal matters were often handled carelessly and sometimes recklessly. With the introduction of the budget system, the standardization of salaries and the centralization of purchases a big forward step was taken in the development of a sound fiscal structure and better fiscal practices. In recent years commendable progress has been made in the procuring of appropriations, the making of allotments, the controlling of expenditures, the checking of costs, and the auditing of accounts. All of this progress shows conclusively that public expenditures for forestry must be analyzed and classified before they can be properly understood, but in spite of this commendable progress, little more than a good beginning has been made in the solution of important fiscal

problems. With an increasing emphasis on the business aspects of forestry, better fiscal plans and practices are urgently needed. The present trend is definitely in the direction of better fiscal administration in forestry. This is a big and important field offering special opportunities to those interested in fiscal matters.

X. REGULAR VERSUS EMERGENCY PROGRAMS

Since 1933 vast sums of federal moneys have been made available for emergency forestry programs. Some of these programs reached proportions far in excess of any previous regular programs. In 1931 federal funds available for forestry work, wildlife management, fish propagation, insect and disease control amounted to $58,000,000. Just five years later (1936) these same federal bureaus and divisions received in direct appropriations and emergency allocations approximately $79,000,000. In addition to this amount $1,250,000,000 were expended annually for new federal activities, chiefly of a conservation nature. That this federal flood of emergency spending for forestry and other emergency conservation work cannot continue indefinitely, is now generally understood. Already there is a slowing down of federal expenditures for these purposes, and it is quite probable that this downward trend will continue. To compensate at least in part for this downward trend in emergency expenditures there must be a corresponding upward trend in regular expenditures or else the forestry programs will move downward. One of the big administrative problems in forestry at present is not the need to stop or attempt to check this downward trend of emergency forestry programs but rather to re-establish and develop adequately the regular forestry programs. Unless this is accomplished reasonably soon forestry as a whole will receive a serious setback. A sustained upswing in regular forestry is an urgent current need to insure an adequate forestry program for the future.

XI. ENLARGED RECREATIONAL OPPORTUNITIES

Until comparatively recently recreational enjoyment of forest areas has been largely incidental in this country. This is no longer true. Instead of living in the forest as our pioneer ancestors did we now go to the forest to enjoy ourselves. And this going to the forest for enjoyment has increased by leaps and bounds during recent years. In 1937 more than 30 million people actually used planned recreational areas and facilities on the national forest alone. Millions more used other recreational areas and facilities on other public and private forest properties. The enormous extension of recreational areas and facilities has by no means been localized. Instead, it has been nationwide in scope and with no let up in sight. The big pressing problem now is to determine the limits of free

recreational opportunities on public forests. The present trend is to make nominal service charges for the use of organized recreational areas and facilities.

XII. INCREASING PUBLIC INTEREST

Among the most active trends in American forestry is the development of a sustained and informed public interest in forestry and other closely related conservation activities. The last five years have witnessed a great awakening of the American people in all phases of conservation. Interest in forestry is welling up in all parts of the country, to such an extent that some forestry leaders now maintain that it is capable of rolling along on its own momentum. That this point of view is far too optimistic is well-known to all who are familiar with the true forestry situation. That public forestry cannot be maintained and certainly not advance without the consent and support of the public is an acknowledged fact. And this public support will not continue unless the public is kept informed. The present trend is not to let down in any way or at any point of educational and information programs now promoting American forestry. Instead, there is a positive trend towards better public education and information along all fronts throughout the entire field of forestry.

XIII. OPPORTUNITIES FOR WORK

Too few people realize the enormous work opportunities in forests and industries dependent on forest resources. It is becoming clearer and clearer that the forest working plans of the future will make provisions for more regular woods work, and from time to time when it becomes necessary, these plans can be expanded to provide for necessary emergency work. It is now common knowledge that forests, both public and private, offer well-nigh unlimited possibilities for employment. Great care must be exercised so that emergency work programs do not destroy or impair regular forestry setups, functions and services. It is far easier to shift from regular to emergency programs than to return from emergency to regular schedules in the handling of public affairs. This however, is an administrative detail. The big fact remains that the American forests offer an almost limitless opportunity for worthful woods work. Let the trend that has started in that direction continue to march forward.

XIV. HUMAN VALUES IN FORESTRY

The most widely discussed trend in American forestry concerns human values. No longer is it sufficient to produce large and sustained supplies of wood and other forest products, no matter how choice their quality, how high their value, or how great their uses. Above all these material values are the still greater human values.

More and more does the wise forester recognize that forests are vital instruments in the services of mankind and so guide the forest enterprise in his charge in the direction not only of sustained yields in wood, but also in sustained yield in health, recreation, inspiration and other human values. We are just on the threshold of a better understanding of the human values of our forests.

XV. ADDITIONAL TRENDS

That there are many more significant trends in forestry, and perhaps some of them fully as important as those considered in this chapter, is recognized by all who are familiar with the general field of forestry and its far-flung ramifications. These additional trends are excellent topics for supplementary study. There is no final stopping place in the study of forestry.

QUESTIONS

1. Why is it important to study significant trends in forestry?
2. Discuss the increase of public forests in the United States. To what extent should the acreage of public forests be increased?
3. What great changes in land use and land ownership have taken place in this country? Are these changes still going on? Why is it necessary to classify land and plan for its use? What shifts in land use are taking place at present in our forests?
4. Is the steady shift towards centralization of powers, influences, and responsibilities in forestry in the best interest of forestry in the long run? Explain.
5. Discuss the present tendency towards closer coordination and better integration of forest activities.
6. Discuss the different types of cooperative effort in forestry, and explain why more and better cooperation is desirable.
7. Tell what is being done throughout the United States to put into use better forest practices.
8. What progress is being made in the direction of sustained yield management in this country?
9. In what manner and to what extent has there been an improvement of forestry personnel in recent years? What special kinds of personnel training is now offered by forestry agencies.
10. Why is it necessary to develop better fiscal administration in the field of forestry?
11. Compare regular versus emergency forestry programs.
12. Discuss the development of necessary recreational areas and facilities.
13. Why is it important to maintain public interest in forestry?
14. Discuss the work opportunities, both regular and emergency, in forests and wood-using industries.
15. Why should human values be considered in the development of forest policies and programs.

REFERENCES

Trends in forestry are ever-changing. At no time in our nation's history have changes in forestry been more rapid than now. Because of these rapid developments the best references will appear in current literature. Many of the best references are not yet written. They will appear from time to time in reports, bulletins, circulars, articles, reviews, and press releases.

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