Author: Pennsylvania Dept. of Forestry

Title: Bulletin, no. 25 - no. 31, 1923

Place of Publication: Harrisburg, Pa.

Copyright Date: 1922 - 1923

Master Negative Storage Number: MNS# PSt SNPaAg250.5

FILMED WHOLE OR IN
PART FROM A COPY
BORROWED FROM:

STATE LIBRARY OF
PENNSYLVANIA

FILMED
AS
BOUND

no. 25 - no. 31

1922 - 1923

FW 1.5
no25

PENNSYLVANIA DEPARTMENT OF FORESTRY

PENNSYLVANIA STATE FOREST ACADEMY

MONT ALTO, FRANKLIN COUNTY, PA.

TWENTIETH YEAR—1922-1923

BULLETIN 25

1922

ROBERT Y. STUART, Commissioner

PENNSYLVANIA DEPARTMENT OF FORESTRY

STATE FOREST COMMISSION

ROBERT Y. STUART,
EDWARD BAILEY
HENRY W. SHOEMAKER
MARY FLINN LAWRENCE (Mrs. John W.)
HENRY S. DRINKER

ROBERT Y. STUART, Commissioner of Forestry.

Wiestling Hall. The Faculty Cottage and the Dormitory Are at the Extreme Right

FOREWORD.

The Pennsylvania Department of Forestry has undertaken the huge task of restoring the forests of the State to their original productive condition. Penn's Woods formerly yielded abundant revenue to the owners, steady work for the wage earners, and healthful living conditions to all. Cheap lumber, pure water supply, stream regulations, and the prevention of erosion are among the benefits the forest brings.

To develop the forest land purchased by the State, trained foresters were needed, and as no institution in the State could or would furnish them, the State Forest Academy was organized twenty years ago to meet the emergency. The State now holds almost a million and a quarter acres of forest land and should acquire five million more.

This announcement for the 20th year is made to the people of Pennsylvania to inform them of the progress and standing of the Academy and to bespeak their hearty cooperation in the restoration of the forests of the State. It is not an extravagant claim to say that the safety and prosperity of the entire State hinge on the success or failure of this movement.

THE FACULTY.

Edwin Allen Zeigler, A. M., Sc. D.
Director and Professor of Forestry.

Willard M. Drake, A. B., M. S. F.
Professor of Forestry.

George S. Perry, B. F.
Professor of Forestry.

Coleman J. Harris, A. M., M. S.
Professor of Biology.

Roland W. Brown, B. S.
Professor of Soils and Chemistry.

W. Harold Horning, B. F.
Assistant Professor of Forestry.

Louis C. Loetzer, B. F.
Instructor in Forestry.

SPECIAL LECTURES.

Special courses such as "Fish and Game", and "First Aid" will be given by special lecturers.

In addition an opportunity is given the students to hear special lectures on forestry, botanical and other subjects. Among these special lecturers will be:

Hon. Robt. Y. Stuart, Commissioner of Forestry.
Dr. John W. Harshberger, University of Pennsylvania.
Dr. O. E. Jennings, University of Pittsburgh.
Mr. R. S. Kellog, Secretary, American Newsprint Association.
Mr. John Foley, Forester, Pennsylvania Railroad.
Colonel Henry W. Shoemaker, Pennsylvania State Forest Commissioner.
Mr. J. S. Illick, Pennsylvania Department of Forestry.
Specialists from U. S. Forest Service, and Pennsylvania Forest Service.
Specialists from the Game and Fish Commissions.

SCHOOL CALENDAR, 1922-1923.

January 3, 1922	Christmas vacation ends.
January 17-21, 1922	First term examinations.
Jan. 23, 1922	Second term begins.
February 22, 1922	Washington's Birthday.
May 30, 1922	Memorial Day.
June 12-17, 1922	Second term examinations.
June 22-23, 1922	Competitive Scholarship Examinations.
June 19, 1922	Summer session begins.
July 4, 1922	Independence Day.
August 3, 1922	Commencement Exercises.
August 4, 1922	Summer session ends.
September 5, 1922	Fall term begins.
November 30, 1922	Thanksgiving Day.
December 15, 1922	Christmas vacation begins.
January, 2, 1923	Christmas vacation ends.
January 15-20, 1923	First term examinations.
January 22, 1923	Second term begins.
February 22, 1923	Washington's Birthday.
May 30, 1923	Memorial Day.
June 11-16, 1923	Second term examinations.
June 21-22, 1923	Competitive scholarship examinations.
June 18, 1923	Summer session begins.
July 4, 1923	Independence Day.
August 2, 1923	Summer session ends.
September 4, 1923	Fall term begins.

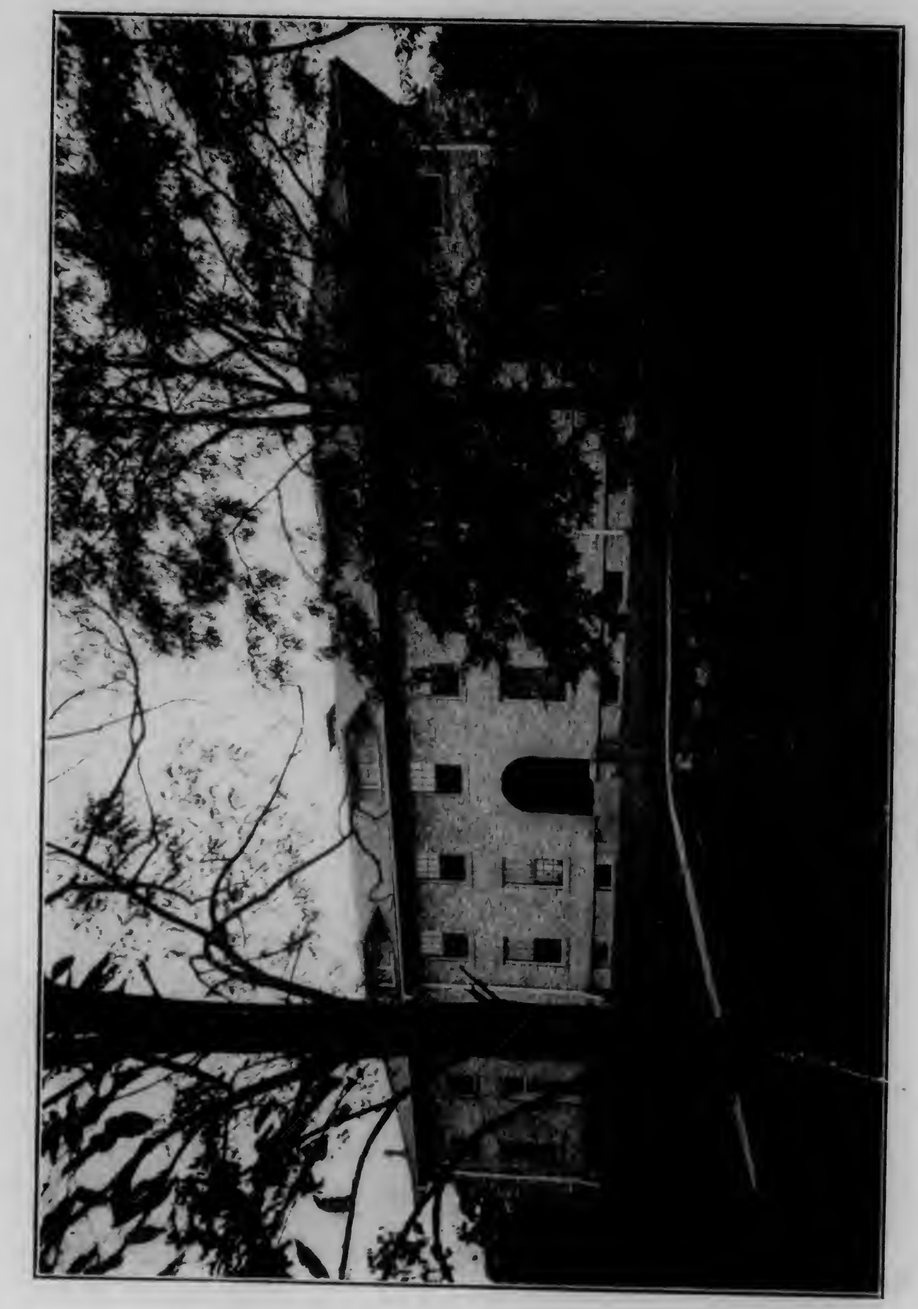
ORIGIN AND EARLY HISTORY.

As early as 1876, in an address before the recently organized American Forestry Association at Philadelphia, Burnett Landreth pointed out the necessity of teaching forestry as a science in itself and not as a branch of agriculture. From that time, throughout the period of agitation and public education which preceded the foundation of the Department of Forestry there continued frequent references to the necessity of such a separate course, or, better still, of a separate school devoted to the teaching of forestry. The European Forest Schools were considered as models, but all recognized the necessity of adapting such a school to American needs and conditions. This agitation was especially strong in the years of 1888 and 1889. During 1889 the trustees of the University of Pennsylvania established a Chair of forestry to be filled as soon as funds became available, but the Chair was never filled.

Because of the slow growth of public sentiment in favor of Forestry, particularly among forest owners, no constructive steps were taken towards the establishment of a technical forestry course until about the year 1900. In issues of "Forest Leaves," in 1901 and 1902, are found several articles dwelling on the necessity of trained men to do forestry work upon the large areas of land which were rapidly passing into the control of the Department of Forestry. Dr. J. T. Rothrock, then Commissioner of Forestry, took the lead in this movement. Endeavors were made to have scientific cources in forestry added to the University of Pennsylvania or to Pennsylvania State College. These schools refused at that time to undertake the work. Appreciating the actual need of men and realizing the great advantages of a practical school connected with actual forest works, Dr. Rothrock decided to establish such a school under the control of the Department of Forestry and locate it upon a State Forest.

In the spring of 1902, Geo. H. Wirt, a Biltmore graduate, was sent to Mont Alto to take charge of the property recently purchased from the Mont Alto Iron Co., and to establish a forest nursery. Although the legislature of 1901 had refused to adopt Dr. Rothrock's plans, he felt sure that two years would find a change in sentiment, and, as a preliminary measure four men were sent to help Mr. Wirt and get some instruction in forestry. In January, 1903, Paul E. Arnold, a German forester, and graduate of the famous Tharandt Forest Academy in Saxony, was added to the teaching force. By act of May 13, 1903, the school was formally established and plans were made for the entrance of the first class. The Forestry Reservation Commission had, however, previously adopted, on June 4, 1902, a curriculum and plan of work submitted by Mr. Wirt for the forest school then in his charge.

The original idea was that the students admitted should be composed of young men from the wooded districts with practical woods experience, and the first class was partly composed of such men. It was soon recognized that these men were often unable to do the mental work required in a study of scientific forestry and the entrance requirements were made strictly competitive with both physique and mental ability entering into the test. This plan was adhered to until 1920, when non-scholarship students were admitted on proof of standard college entrance preparation.



The Forest Academy Dormitory

At first there was some thought of moving the school to the Caledonia purchase as possessing better facilities, but this was finally given up and the administrative buildings of the old furnace at Mont Alto were utilized for the school. These were far from being ideal, and consequently the school was materially handicapped until 1908, when ground was broken for the first of the present group of modern buildings.

LOCATION.

The Pennsylvania State Forest Academy is located about one mile from Mont Alto, a village in Franklin County, which is sixty miles southwest of Harrisburg on the Cumberland Valley Division P. R. R. The ground occupied by the school buildings is a part of the Mont Alto State Forest, which affords an opportunity for practical instruction and experimentation equalled by few, if any, American forest schools. One of the foremost forestry educators of the United States called the Pennsylvania State Forest Academy, because of its excellent location, "the gem of American forest schools." The situation is healthful and the school is supplied with water from a spring located in the interior of the 23,000 acre forest. To the west of the school lies the Cumberland Valley which is regarded as one of the garden spots of Pennsylvania, and nearby are some of the most scientifically managed apple and peach orchards of the State.

The forest location of the school stands in strong contrast with those in larger cities and college towns. Such a situation has advantages which make it not only attractive but also convenient for the study and practice of forestry in the forest throughout the year. It enables the student to study forestry rather than about forestry.

BUILDINGS.

Thirteen buildings comprise the Academy group. Wiestling Hall the oldest of the buildings, is a large three story structure and was formerly the residence of Col. George B. Wiestling, a member of the first Forestry Commission of Pennsylvania. This building has recently been remodeled and is now used as an administration building. It also contains the dining room, kitchen, and quarters for the matron and servants.

The Main Building was erected in 1908-09. It is the largest building of the group and is constructed of a very attractive native quartzite. On the second floor of this building are comfortable living rooms for all the students. The first floor is devoted to class rooms, laboratories, and the library. In the basement are a recreation room, a wood specimen room, and a furnace room. The building is supplied with steam heat, illuminated with electricity, and furnished with necessary toilet rooms and lavatories.

The Faculty Cottage.

A double cottage, occupied by the Director and another member of the faculty was built in 1911. Three other single cottages are occupied by instructors or are available for their use. Other buildings, such as machine shop, log lodge, gymnasium, sawmill, wagon shed, stable, and seed storage house dot the campus.

CAMPUS.

A spacious and attractive campus surrounds the school buildings. Upon it are many native and exotic trees and shrubs. The most distinctive and impressive features of the campus are the massive Black and White Oak trees which are remnants of the original forest and bear mute evidence of many vicissitudes during an existence of more than two centuries. Amidst these stately trees are carefully laid out drives and walks, and a meandering brook of pure mountain water. Overlooking all this picturesqueness is the productive and carefully managed Mont Alto State Forest.

FACILITIES FOR INSTRUCTION.

The facilities at Mont Alto for instruction in forestry compare favorably with any in America. The laboratory equipment is modern and complete. The school forest, nursery, and arboretum are easily accessible and afford object lessons which cover a wide range of forestry problems. The proximity of the school to its out-door working field economizes much time which would otherwise be spent on the road.

The biological, chemical, and soil laboratories are adequately equipped with modern appliances and fully stocked with necessary working material.

Numerous collections have been prepared and are available for demonstrating lectures, laboratory work, and special investigations. A herbarium of more than 4,000 specimens of native and exotic woody and herbaceous plants is carefully classified and available for study purposes. A collection of forest tree fruits, seeds, and seedlings is in progress. Typical specimens of wood destroying and parasitic tree fungi are on exhibition in a small museum. Many species of forest insects have been collected and specimens of their work are available for study and demonstration purposes.

In the basement of the main building is a room 16 x 60 feet containing a collection of all the important commercial woods of the United States and some foreign woods. These woods are used in the course in Wood Identification.

A collection of tools, instruments, and machines used in lumbering, silvicultural operations, protective work, and mensuration exercises is in progress. It contains planting hammers, fire torches, fire rakes, brush hooks and other implements designed by Pennsylvania and other American foresters. It also embraces representative European instruments.

The school is adequately equipped with the best and most practical instruments required in the practice of forestry. The surveying equip-

Students Identifying Trees.

Counting and Bundling Seedlings in the Forest Academy Nursery.

An Exercise in Forest Mensuration.

ment is complete and up to date. The forest mensuration equipment comprises the best types of American and representative European calipers, hypsometers, increment borers, xylometers, chains, tapes, and other necessary instruments.

The library comprises all the standard texts on forestry in the English language and many publications in foreign tongues. All the principal forestry periodicals and representative lumber, trade, and technical journals are received regularly and filed systematically for future references.

A large collection of carefully selected charts and photographs covering all phases of forestal activities, is available for use and furnishes the best kind of illustrative material for class work. Lantern slides, covering the major forest operations and typical forest conditions are in stock and are used to illustrate classwork.

For field work in forestry the vicinity of Mont Alto offers unsurpassed facilities. The latitude and topography favor a rich flora. It is the meeting ground of northern and southern species. The northern follow the mountains towards the South and the southern extend northward through the valleys. Within one mile of the school buildings occur more than 100 species of native woody plants and many introduced species. The richness of the local woody and herbaceous flora and its proximity to the school make it possible and practical to give the major part of the instruction in Tree Indentification and Systematic Botany in the forest and nearby field without spending an excessive amount of time on the road.

A five-minutes walk from the school brings one to a forest nursery with an annual capacity of 2,000,000 seedlings. It is well equipped with modern nursery appliances, and in it the students learn, not by general observation but by actual work, nursery practice from the preparation and sowing of seed beds to the packing and shipping of seedlings and transplants.

The Mont Alto State Forest has been under careful and business-like management for the past seventeen years. It is dotted with plantations, experimental sample plots, improvement cuttings, fire towers, and ranger stations, ramified by roads and trails, covered with fire, compartment, and telephone lines, and partly divided into blocks, compartments, and stands. The plantations contain many different species of trees ranging in age from 1 to 19 years and cover an aggregate area of over 600 acres. Improvement cuttings have been made annually since the creation of the forest. A study of the effect of light, medium, and heavy thinnings has been in progress for five years. One steel and two wooden towers have been erected at commanding lookout points. They and the ranger's houses are connected with the forester's headquarters by a state owned metallic circuit telephone system, whose aggregate length is more than 26 miles.

The utilization operations are among the most interesting and instructive on the forest. Fuelwood, posts, and poles are harvested on a large scale. A state-owned portable sawmill, stave mill, shingle mill, and lath mill are operated on the forest. The students, as a part of their course in Lumbering work upon these mills and learn to handle the different positions from felling the trees and firing the boiler to head sawer and timber scaler. Briefly, the students are kept in constant contact with all the operations of a forest business, and are taught the best and most efficient methods of handling a forest property both by precept and practice.

SPECIAL LECTURES.

The faculty arranges annually a course of free lectures. These instructive and helpful talks are given to the students by men of prominence in subjects allied to forestry. They cover travel, history, civics, literature, first aid, wood craft, personal health, and other timely topics.

PURPOSE.

The purpose of the Pennsylvania State Forest Academy is to prepare thoroughly trained foresters for the service of the State in its forests. The duties of a forester in the employ of the State require a thorough training and apprenticeship in actual woods work, besides the usual school studies in forestry, the sciences, and a number of cultural subjects. The forester must have an equipment covering the surveying and mapping of his forest; the growing of trees and their proper management from planting, through thinning, to final logging and sawing; the protection of the forest from its arch-enemy, the forest fire, as well as from insects, disease, and trespass; the building and improvement of the forest roads, trails, fire lines, telephone lines, and the fire towers; the estimation of timber and the calculation of its growth, value, and financial returns; the directing of labor; the keeping of records and accounts; and some knowledge of business and forest law. This requires an underlying training in mathematics, botany, zoology, chemistry, physics, geology, and soils, as well as history, language and economics.

The practical application of this training is the large feature of the school, for the entire course may be said to be given in the 70,000 acres of the Mont Alto and Michaux State Forests in which the school is located. All the activities of the forester are followed in the woods from the growing of trees from seed in the nursery, to the grinding of the forest student's own axe, the cutting of undesirable trees into cordwood, and the mature trees into saw-logs, as well as their manufacture into lumber, lath, staves, and shingles on the school mills; from the day and night fighting of forest fires and the pick and shovel building of roads to the preparation of a thorough working plan for a specified tract of forest land.

But beyond all this technical training, the school aims to develop men who love the forest, for a successful forester must look upon the forest as more than a mere clump or collection of trees. He must see in it a complex community or society of living things and be on a speaking acquaintance with them all. He should know the wild animals, birds, plants, and rocks so well that he finds interest in them. A good forester should not be lonesome in the forest, but instead find continuous contentment in his extensive out-door laboratory.

Last, but not least, the school aims to graduate men who love the people of the forest, if not for what they are, at least for what he hopes they will become. A forester must be a man of parts with whom the people of the forest communities are glad to associate, willing to do ordinary business on a reliable basis, and discuss everyday problems with interest and benefit.

ADMINISTRATION.

The control of the school is vested by legislative enactment in the Commissioner of Forestry. The pedagogical supervision and immediate government is delegated to a Director and school faculty.

FACILITIES FOR RECREATION.

The student body maintains an athletic association. Athletic contests are not engaged in so extensively as at some other educational instructions because the students obtain sufficient physical exercise in their field work which takes them out doors at frequent intervals during the entire year. A baseball diamond, a double tennis court, a billard table, and gymanastic equipment are available for use.

Basket-ball is the most popular game. It is especially adapted to a small student body and engaged in during the winter when field trips and forest exercise are few in number and of short duration. The schedule comprises games with normal schools and small colleges.

Hunting and fishing are among the most popular sports. The Mont Alto and Michaux State Forests of 70,000 acres and adjoining forest properties and abandoned fields afford excellent and convenient hunting grounds. Within the forest is a game refuge of 2,000 acres in which wild animals and game birds are propagated systematically. Deer, oppossums, raccoons, wood chucks, squirrels, rabbits, pheasants, and quail are plentiful, and wild turkeys and foxes, are occasionally seen. It is not unusual to see a herd of fifteen or more deer. In spring time, trout fishing offers an enjoyable form of recreation. The nearby mountain streams are numerous and well stocked.

Many points of historic interest are the objectives of week-end walking trips. Among these may be mentioned the Gettysburg and Antietam battlefields, President Buchanan's birthplace, and Pen Mar, a summer resort located on a high mountain at a point crossed by the Mason and Dixon line. Walks to local high points and commanding lookout towers are frequently scheduled. On the Mont Alto forest are one steel and two wooden towers 50 feet in height, affording excellent views of the extensive timbered mountain slopes and the fertile Cumberland Valley, which is surpassed in Pennsylvania only by the Lancaster Valley in its agricultural capacity.

FOREST CLUB.

The Rothrock Forest Club is a student organization named in honor of Dr. J. T. Rothrock, the founder of the school and for many years the leader of the forestry movement in Pennsylvania, and in the United States. The meetings are held in Log Lodge, a commodious log building finished in southern yellow pine and heated by a spacious fire-place. The program of the meetings is similar to that of literary societies at other educational institutions. The club is also the agency through which the students are introduced to prominent men in forestry and other professions.

SCHOOL YEAR.

The school year is divided into the first and second terms and the summer session. The first term begins on the first Tuesday of September and extends to the latter part of January. The second term begins the last week in January and extends to the middle of June. The summer session begins immediately upon the termination of the second term and extends to the early part of August, when a four weeks recess begins.

A two weeks recess during the Christmas Holidays is provided each year. Four weeks in April and May are devoted entirely to planting and nursery work. The school year thus covers 46 weeks. This is a considerably heavier course than is given in any other four year forestry school in the United States.

REQUIREMENTS FOR ADMISSION.

The general requirements for entrance to this school are as follows:

1. Applicants for admission to the Freshman class must be at least 17 years of age and must submit to the Director of the School proper testimonials of a good moral character.
2. Every applicant for admission shall have completed a 4 year High School course or satisfactory equivalent.
3. Students desiring to enter with advanced standing must present properly signed certificates from other colleges covering the subject pursued at such institutions.
4. Students must enter at the beginning of the fall term and not later than September 19, 1922, unless they have advanced standing to cover the work done by the classes they wish to enter.

SPECIFIC SCHOLARSHIP REQUIREMENTS:

The scholarship required of all applicants for entrance to the Freshman class is evidence of thorough preparation in fifteen units of High School work or its equivalent. A unit of High School work is the amount of work represented by five recitations a week for a school year of at least eight months or a minimum of 160 hours of recitation work or equivalent laboratory work.

The required units for entrance to the Freshman class are as follows:

English	3 Units
Mathematics (Elem. Algebra, Plane Geometry Advanced Algebra, Solid Geometry	3 Units
Science (Botany, Physics, Chemistry, Physical Georgraphy; etc.,)	1 Unit
History	1 Unit
	8

The elective units to make up a total of 15 should be selected from the following subjects:

English
Language, other than English
Mathematics.
History.
Science.
Civics.
Vocational Subjects.

The number of units to be allowed will be determined by the Director of the Academy. If students do not maintain the scholarship standards of the school, they will be dropped.

Application Forms:

Each applicant is required to submit a properly executed application for admission. Application form may be obtained from the Director, State Forest Academy, Mont Alto, Franklin County, Pa.

State Scholarships:

The State Department of Forestry offers not to exceed ten four-year scholarships annually. The candidates for these scholarships must be "Citizens of Pennsylvania, not less than 17 or more than 25 years of age on the first day of September of the year of entrance, must be physically sound as shown by physical examination and must take a mental examination in Scholarship which covers the following branches: English (Grammar, Composition and Rhetroic); United States History; Civil Government; Arithmetic with special emphasis on Mensuration, Interest, Proportion, and Progression; Algebra (complete High School Algebra); Plane Geometry, and Biology (including Human Physiology)".

The examination for 1922 will be held on June 22 and 23 at Harrisburg. Candidates will report at the Department of Forestry, Capitol Building, 9 to 12 A. M. June 22.

The mental examination will begin at 1.30 P. M. June 22 and will be completed June 23 by 2:00 P. M. The examination is held by a selected committee of high school teachers who correct and grade the papers.

The highest ten men who pass the examination are assigned to certain State forests for six weeks practical work beginning July 1 for instruction and observation, during which their attitude toward and their fitness for the work of a forester is determined. Those who prove satisfactory in this work will be offered the scholarships by the Commissioner of Forestry. During this field-test applicants will pay transportation charge to and from the forest to which they are assigned and the Department will pay their board and lodging. Camping may be required.

Conditions of Scholarships:

After appointment each scholarship student must furnish bond of $500 that he will complete the four year course and remain in the State Forest Service, in case his services are needed, for three years at such salary as the department may reasonably offer. On its part the State Department of Forestry contracts to provide the student, free of charge. the following for the four year course: tuition, board, room, heat. light, stationery and plain washing.

Estimated Minimum Expenses Per Year:

	Non-scholarship students.		Scholarship students.
	Penna.	Outside State	
Tution	Free	$150	Free
Board, 46 weeks @ $5½	$253	253	"
Room, furnished, heat, light, 46 weeks, @ $1½	69	69	"
Books and Instruments	35	35	$35
Laundry, 46 weeks @ .50	23	23	Free
Forestry Club, Athletic & Social	25	25	25
Expenses on field & Inspection trips	10	10	10
Deposit-Breakage	5	5	5

Clothing, personal and traveling expenses are impossible to generalize,

Students using school laundry will provide themselves with red woven laundry marks giving full name. (Order before entering from Book-Room, Forest Academy).

Deposit:

When a student enters the Academy he must make a deposit of $5 with the Director, against which will be charged all items of unnecessary, careless, or wilful breakage or damage to State property. Whenever deposit is lowered by reason of charge against it, the student will be required to increase the deposit at the beginning of each school year to the full amount of $5. At the time of graduation there will be returned to him whatever balance may remain to his credit.

Non-scholarship applicants must deposit $10 to hold room when application is accepted. They must also furnish a bond of $200 on entering, as a guarantee that all fees will be met.

Degree:

For the satisfactory completion of the full four years course as prescribed, the degree of Bachelor of Forestry is conferred.

COURSE OF STUDY.

Freshman Year.

First Term.			Second Term.		
Number of course.	Subject	Credit hours.	Number of course.	Subject	Credit hours.
11	Botany	4	12	Botany	4
18	Chemistry	3	19	Chemistry	3
F 1	Elementary Forestry	2	22	Drawing	1
1	English	3	F 2	Elementary Forestry	2
34	German or French	2	35	German or French	2
21	Mathematics	4	2	English	3
27	Trucks & Mechanics	2	23	Plane Surveying	1
			29	Physics	3
			28	Shop	1

Summer Session.

13	Botany	2
F 6	Silviculture	2
F 3	Forest Mensuration	2

Sophomore Year.

First Term.			Second Term.		
14	Botany	2	F 10	Dendrology	3
20	Chemistry	2	4	English	3
3	English	3	37	German or French	2
32	Geology	3	31	Meteorology	2
36	German or French	2	33	Soils	3
38	(Elect) Pa. History	3	25	Surveying	2
30	Physics	3	15	Zoology	3
24	Surveying	4	F 4	Forest Mensuration	2

Summer Session.

F 11	Dendrology	1
F 5	Forest Mensuration	2
26	Forest Map	3

Junior Year.

First Term.			Second Term.		
5	Accounting	1	8	Business Law	2
F 12	Dendrology	2	F 18	Forestry History	2
F 19	Forest Engineering	3	F 14	Forest Pathology	3
F 13	" Entomology	3	6	General Economics	4
F 15	" Protection	2	F 22	Lumbering	4
F 20	Mech. Properties wood.	2	F 8	Silviculture	3
F 7	Silviculture	3	F 21	Wood Indentification	1
17	Wood Morphology	2			
16	Zoology	2			

Summer Camp.

F 23	Logging & Milling	4

Senior Year.

First Term.			Second Term.		
F 25	Forest Economics & Policy	3	10	Fish Propagation	2
F 26	Forest Finance	4	F 29	Forest Administration	3
F 16	Forest Regulation	3	F 28	" Appraisal	3
9	Game Propagation	2	F 27	" Laws	3
7	General Economics	2	F 17	" Organization & Working Plans	4
F 9	Silviculture	3	F 31	Seminar	1
F 24	Wood Utilization	4	F 32	Thesis	5
F 30	Seminar				

Students Identifying Wood.

A Forest Surveying Crew.

DESCRIPTION OF COURSES.

F 1. ELEMENTARY FORESTRY.

2 credit Hours. *First Term, Freshman Year.*

A course to give the student a broad introduction to all phases of work in forestry, and of the relation of forestry to other sciences and to the nation's economic life. Text work and field trips in State forest are required. Moon & Brown's *Elements of forestry* is used as text.

F 2. ELEMENTARY FORESTRY.

2 Credit Hours. *Second Term, Freshman Year.*

The course aims to give the students a through knowledge of the distribution of Forests in the United States and the development of the forestry idea in United States and in Pennsylvania.

F 3. FOREST MENSURATION.

2 Credit Hours. *Summer Session, Freshman Year.*

Introduction to the subject; lectures and field work on the measurement of felled trees in various units.

F 4. FOREST MENSURATION.

1 Credit Hour. *First Term, Sophomore Year.*

The course aims to give the student a through knowledge of methods used in measuring volumes of single trees, either felled or standing, and of the determination of growth and yield. Graves' *Forest Mensuration* is used as text.

F 5. FOREST MENSURATION.

2 Credit Hours. *Summer Session, Freshman Year.*

This course consists of field work in measuring stands of timber, and study of growth and yield of stands, especially in collecting data for a working plan.

Estimating Timber.

Students Measuring Tree Heights with Instruments.

F 6. SILVICULTURE & NURSERY PRACTICUM.

2 Credit Hours. *Summer Session, Freshman Year.*

Operations on the Mont Alto State Forest of 23,000 acres permit students from time to time throughout their course, to take part in practical improvement, liberation and reproduction cuttings, cleaning and protection of the extensive plantation areas; but these activities, together with planting, serve especially to introduce future foresters to actual silviculture in the woods. The nearby state forest nursery of eleven acres under intensive cultivation produces annually 2,000,000 trees for reforestation work. Students take an important part in soil preparation, seed sowing, transplanting, cultural and protective measures, together with lifting, grading and packing trees for transportation. An instructor and skilled workmen are always present to make this work instructive as well as practical.

F 7. SILVICULTURE (SILVICS OR FOREST ECOLOGY, AND FOREST GEOGRAPHY).

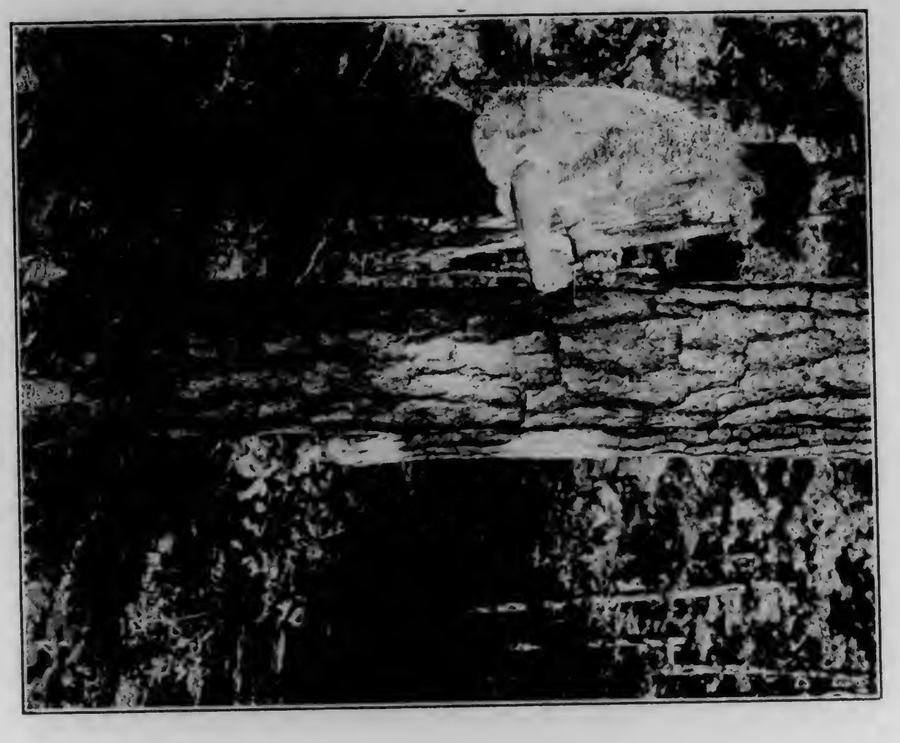
3. Credit Hours. *First Term, Junior Year.*

The primary effects of heat, light, wind, moisture and soil upon tree growth and distribution are thoroughly discussed; followed by the effects of forests on climate and soil, the internal struggle of the stand, site quality assessment, stand description and forest types. Application of the basic facts of silvics and dendrology to the actual forest is made in a series of lectures in forest geography and physiography; embracing a detailed study of the forest regions and types of the United States and Canada, with a general survey and discussion of the important forest areas of the world noting in particular their structure, ecology and possibility of economic development. Many references are used and abstracts required of each student. Considerable material given in the course is derived from Schlichs *Silviculture,* Mayr's *Waldbau, and* Bowman's *Forest physiography.*

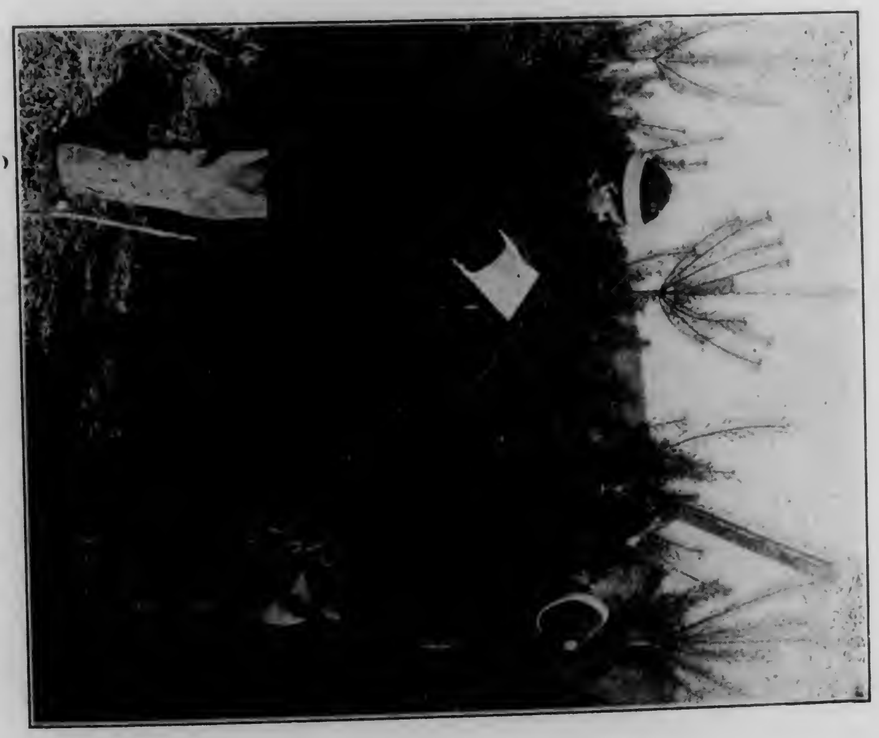
F 8. SILVICULTURE. (SEEDING AND PLANTING).

3 Credit Hours. Second Term, Junior Year.

Seed production, collection, extraction and storage, nursery work and administration. Direct seeding and plantation establishment. Reforestation problems and progress are studied in the field and a planting plan prepared for a definite area of denuded land. Under trained and skilled supervision, students follow the trees through each stage of nursery practice, from staking out beds to final shipment or planting in the forest. Problems in nursery management, technique and protection are discussed in detail. Students participate in various experimental work which is always under way, and are given experience in directing work in nursery and planting operations. Costs are calculated for work done and stock produced; inventories are made; nursery accounting and plantation report forms are explained and used. Toumey's *Seeding and Planting* is text used with supplementary notes from other sources.



Finding the Age of a Tree



Measuring Height Growth of Scotch Pines.

F 9. SILVICULTURE. (SYSTEMS OF NATURAL REGENERATION).

3 Credit Hours. *First Term, Senior Year.*

Critical comparisons are made between pure and mixed woods, high and low forest forms; natural and artificial regeneration; the silvicutural systems; methods of thinning, forest conversion and improvement. Cleanings, liberation and damage cuttings, and treatment of wood-lots are considered from an experimental as well as theoretical and empircal standpoint. The location of the school here where the South Mountains, managed for a century prior to their acquisition by the state for continous yields of charcoal for the iron industry, adjoins an extensive agricultural area with scattered farm wood-lots, give it a vast natural outdoor laboratory for silvicultural instruction. This has been improved during the past twenty years by the establishment of more than 600 acres of plantations of many species and upon a variety of sites. Hawley's *Silviculture* and Graves' *Principles of Handling Woodlands are* the texts used, with Schilch's *Silviculture,* Mayr's *Waldbau* and *Traite Pratique de Silviculture by* Jolyet as chief reference works.

F 10. DENDROLOGY.

3 Credit Hours. *Second Term, Sophomore Year.*

A systematic and biological study of the trees of the United States and introduced species, stressing the important timber producers. Special attention is given coniferous species native to temperate climates similar to that of Pennsylvania. Form, distinguishing characteristics, reproduction, occurrence and range are taken up in detail. In the first semester tree indentification in the field is begun by a series of brief trips and a collection of winter buds, mounted on cards and representing 150 species, as required. Keys are worked out by the students for both winter and summer use. About 100 important trees of the locality are observed thru-out the year by assigned students and phenological data recorded. The growing school collection of photos, slides, herbarium mounts and other dried material of the important forest species adds interest to lecture room instruction. In addition to numerous references, texts especially followed are: Illick's *Pennsylvania Trees;* Sargent's *Manual of Trees of North America;* Hough's *Handbook of Trees of Northeastern United States and Canada;* Mayr's *Fremländische Wald- und Park bäume für Europo;* Publication of the U. S. Forest Service, by Geo. B. Sudworth and others.

F 11. DENDROLOGY. (TREE INDENTIFICATION).

1 Credit Hour. *Summer Session, Sophomore Year.*

A field course embracing the study of all woody vegetation in the vicinity of Mont Alto, where more than 150 species of trees and shrubs are native within a radius of ten miles. Including exotics,

students are familiarized with about 250 species. The Forest Academy is so located that it lies within the ranges of many northern and southern trees which overlap here, and this naturally advantageous site has been supplmented by an arboretum, containing the more important forest trees of the Western U. S. and temperate foreign countries. In addition to many half days spent in adajcent forest and fields, during the course all-day field-trips are made to the Potomac River, North Mountains, Pen Mar and several localities in the fertile and historic Cumberland Valley, permitting the study of trees under widely varying conditions of growth and habitat. Field tests cover 800 to 900 specimens. Texts used are Illick's *Pennsylvania Trees* and *Checklist of Trees of Franklin County.*

F 12. DENDROLOGY.

3 Credit Hours. *First Term, Junior Year.*

Continuation of course (F 10.)

I 13. FOREST ENTOMOLOGY.

3 Credit Hours. *First Term, Junior Year.*

A general discussion of the morphology, physiology, development and classification of insects; the life history of both beneficial and injurious species, with special reference to those forms which are of economic importance in the forest. Sanderson and Jackson's *Elementary Entomology* is the text used, supplemented by reference to various State and National bulletins on insects of economic importtance.

F 14. BOTANY, FOREST PATHOLOGY.

3 Credit Hours. *Second Term, Junior Year.*

A course considering representative tree diseases caused by cryptogamic parasites and saprophytes and parasitic flowering plants. Preventive and remedial measures for checking their damage are discussed. Class and laboratory are supplemented by field exercises. Rankin's *Tree Diseases* is the text used.

F 15. FOREST PROTECTION.

2 Credit Hours. *First Term, Junior Year.*

Lectures and reference reading covering a complete discussion of general forest protection with special detailed discussion of protection against fire. Special reference is made to Pennsylvania conditions and actual field work in forest protection is included in the course as part of the school work. All students are enrolled in organized fire crews and take part in the extinction of forest fires on the Mont Alto and Michaux Forests.

F 16. FOREST REGULATION.

3 Credit Hours. *First Term, Senior Year.*

The broad and general principles of forest management are first considered. Every effort thru-out the course is directed toward the practical correlation and application of facts, data and rules derived in other scientific and forestry courses. A proper and clear concept of the normal or ideal forest with continuous yield and other attributes, is held before the student until every phase is firmly grasped. The fundamentals of increment, growing stock and age classes are studied in detail; then follows the drafting of formulation of felling budgets and solution of problems that arise in the effort to attain normality upon forest areas with given conditions. Critical studies are made of the various formulae and method whereby an approximation to the normal forest may be achieved. Texts used are Roth's *Forest Regulation* and Recknagel's *Theory and Practice of Forest Working Plans.*

F 17. FOREST ORGANIZATION AND WORKING PLANS.

4 Credit Hours. *Second Term, Senior Year.*

This course is a continuation of that in Forest Regulation but embodies more field work and takes up geometric, quantitative and qualitative surveys of a specific forest area, with the theory and practice of forest subdivision and stand differentiation. A portion of a State Forest is annually taken up and divided into permanent compartments for silvicultural and administrative purposes. Careful stock surveys, made in conjunction with sophomore class in mensuration, furnish a basis for the creation of more or less temporary sub-compartments, coextensive with some definite and important stand condition, such as age, species, density, site or future silvicultural treatment. The compartment lines are demarcated upon the ground, while the lines of sub-compartments usually are not. Working plan reports and maps are required of each student, and all necessary facilities for efficient work toward this end, such as transportation and technical instruments, are furnished by the school or forest officers. References used include Schlich's *Forest Management, Kaiser's Einteilung der Forsten* and Wagner's *Grundlagen der raumlichen Ordnung im Walde.*

F 18. FOREST HISTORY.

2 Credit Hours. *Second Term, Junior Year.*

A course giving more or less detailed information as to development of forest property, forest conditions, forest investigation, and handling of forest properties for timber production in the principal countries of the world. Special attention is given to development of forestry in Pennsylvania. Fernow's *History of Forestry* is used as a text.

F 19. FOREST ENGINEERING.

3 Credit Hours. *First Term, Junior Year.*

Principles of forest roads, practical survey and construction. Construction of trails, bridges, telephone lines, fire towers.
Logging railroads, grades and curves.
Finding the flow of springs and streams.
Roads text—*Highway Engineering—Chatburn.*

F 20. MECHANICAL PROPERTIES OF WOOD.

2 Credit Hours. *First Term, Junior Year.*

This course aims to acquaint the student with the physical properties of wood, the factors that affect them, and the methods giving these properties actual values through timber testing. Record's *Mechanical Properties of Wood* is used as text.

F 21. WOOD INDENTIFICATION.

1 Credit Hour. *Second Term, Junior Year.*

A detailed study of the methods used and practice on actual specimens of the various important commercial woods of the United States.

F 22. LUMBERING.

4 Credit Hours. *Second Term, Junior Year.*

This course aims to show in detail how the products of the forests are harvested, and prepared for the market. It includes actual work in the woods and the manufacture, in a state owned plant, of lumber, shingles, lath, ties, etc. The text in use is Bryant's *Logging.*

F 23. LOGGING AND MILLING.

4 Credit Hours. *Summer Session, Junior Year.*

This course includes a 6-8 weeks trip to a large saw-mill operation and includes a study of methods, costs, etc., from stump to car and a detailed report on the same.

F 24. WOOD UTILIZATION.

4 Credit Hours. *First Term, Senior Year.*

This course includes a study of the industries that further manufacture the timber and other rough materials removed from the forest in lumbering operations. It includes a study of the wood using industries of Pennsylvania. The texts used are Brown's *"Forest Products"* and *Wood Using Industries of Pennsylvania* (Dept. Bulletin No. 9).

A Lesson in Saw Filing.

Students Making Chestnut Shingles.

F 25. FOREST ECONOMICS AND POLICY.

3 Credit Hours. *First Term, Senior Year.*

A study of the social utilities flowing from forests and the importance of forests and forest products in industry. The continuing depletion of our forests; the possibilities for contiuous production. The policy of nations, states and municipalities toward forest propagation. Government ownership, control and cooperative policies.

Lectures

F 26. FOREST FINANCE.

4 Credit Hours. *First Term, Senior Year.*

Forest property from the investment point of view. Calculation involving principles of compound interest and annual charges: Interest rate; net income; financial maturity; carrying charges; methods of comparing financial results under different methods of treatment; forestry compared with agriculture; forest taxation. References, Roth's *Forest Valuation* and Chapman's *Forest Valuation.*

F 27. FOREST LAWS.

3 Credit Hours *Second Term, Senior Year.*

A brief review of the Forest Laws in the U. S. Texts, Kinney on *Forest and Timber Law.*

Supplemented by a course of lectures on the powers of forest officers as peace officers.

F 28. FOREST APPRAISAL.

3 Credit Hours *Second Term, Senior Year.*

The valuation of forest properties; determination of stumpage values; assessment of forest damage. Lectures.

F 29. FOREST ADMINISTRATION.

3 Credit Hours *Second Term, Senior Year.*

This course aims to acquaint the student with the principles used in the organization of the business administration and personnel to care for forest property. The present status and methods used in the State Forests, National Forests and Private Forests will be discussed. Lectures and reading.

F 30. SEMINAR.

1 Credit Hour *First and Second Term, Senior Year.*

A round table discussion of professional forestry movements, events and literature. Includes preparation of papers, reviews and, leading discussions.

F 31. THESIS.

5 Credit Hours. *Last 6 weeks, Senior Year, Second Term.*

Each student will make a special field study of a subject approved at the end of the Junior year. These subjects will generally fall under the heads of transportation, seasoning, preservation, or price studies of lumber; timber accounting; special product studies; silvicultural or management investigations, etc.

1. ENGLISH.

3 Credit Hours *First Term, Freshman Year.*

This course includes a review of the essentials of English grammar, the rules for capitalization, punctuation, and business correspondence. Themes on pertinent subjects are required frequently. *"English Composition in Theory and Practice"* by Canby and others is the text used, *Woolley's Handbook of Composition* is used for reference.

2. ENGLISH.

3 Credit Hours *Second Term, Freshman Year.*

The whole field of prose and poetical composition is studied in general and detail from the standpoint of the three underlying principles governing all good composition: unity, coherence, and emphasis. Themes and other exercises illustrating these principles are required. The mechanics of writing are continued as in English 1. Representative classics are read.

3. ENGLISH.

3 Credit Hours *First Term, Sophomore Year.*

A brief review of world literature as a whole, followed by a summary of English and American literature with particular attention given to the study of the scientific writings of such authors as Roosevelt, Muir, Burroughs, Thoreau, and Fabre.

4. ENGLISH.

3 Credit Hours *Second Term, Sophomore Year.*

A continuation of English 3 with emphasis upon the encouragement of the student to put his English into effective, practical use by exercises in debating, public speaking, and parliamentary practice. Themes.

5. ACCOUNTING.

1 Credit Hour *Junior Year, First Term.*

Principles of accounting: Single and double entry procedure: Different kinds of accounts: Depreciation budgets: Accounting as applied to forest finances and records: Pennsylvania Dept. of Forestry prescribed accounts. Use of checks, drafts, notes, mortgages.

6. ECONOMICS.

4 Credit Hours *Second Term, Junior Year.*

Principles of economics, Capital; Labor; Business Organization; Money and Banking; Monopoly; Transportation. Taussig's *Principles of Economics Vols. 1 & 2.*

7. ECONOMICS.

2 Credit Hours *First Term, Senior Year.*

Continuation of Economics 1, followed by a study of Taxation and Public revenue.

8. BUSINESS LAW.

2 Credit Hours *Junior Year, Second Term.*

An elementary study of Elements of Business Law with special reference to contracts, and property. Huffcut's *The Elements of Business Law,* is the text used.

9. GAME PROPAGATION.

2 Credit Hours *First Term, Senior Year.*

Course of lectures by Specialist from Game Commission. A state game preserve located on the school forest is a valuable object lesson in game propagation. The school forest now contains hundreds of deer and much smaller game.

10. FISH PROPAGATION.

2 Credit Hours *Second Term, Senior Year.*

Course of lectures by Specialist from the Fish Commission.

11. BOTANY.

4 Credit Hours *First Term, Freshman Year.*

Morphology of the Spermatophytes.

A course specially adapted to the early and fundamental training of the forester. It comprises a study of the external and internal morphology and physiology of the six primary parts of the seed bearing plants. Tree material is used where possible to illustrate the different parts of the plant system. Part 1 of Ganong's *"A Text-book of Botany for Colleges"* is used.

12. BOTANY.

4 Credit Hours *Second Term, Freshman Year.*

Evolution of the Plant Kingdom.

A careful study of the morphology of representative examples among the algae, fungi, liverworts, mosses, ferns, gymnosperms and angiosperms is pursued in the laboratory and in the field. Special

attention is given to the alternation of generations in the plants studied and in working out their life histories, the progression and retrogression of certain organs and phases in proceeding from the lower to the higher plants are noted. Field trips are made once a week to enable the student to collect and study the plants in their natural habitats. Part 2 of Ganong's *A text-book of Botany for Colleges* is used.

13. BOTANY.

2 Credit Hours — *Summer Session, Freshman Year.*

Taxonomy.

A comparative study is made in the field of the families of plant groups and special training is given in the methods of collection and preservation of material. Each student is required to make an herbarium of at least 125 species of herbaceous plants and to learn common and scientific names of at least 180 plants. Emphasis is laid on the key for indentification of the plants. Gray's *New Manual of Botany* and Britton and Brown's *Illustrated Flora of the Northern States and Canada* are the text and reference used.

14. BOTANY.

2 Credit Hours — *First Term, Sophomore Year.*

Plant Ecology.

The course deals with the relation of plants to their envoirment. First, there is a study of the ecological factors, which in general are grouped under physical, climatic and biotic factors. This is followed by a discussion of succession, the struggle for existence among plants, the laws of migration, the analysis of vegetation forms and structures, plant formations and societies.

In the laboratory, different members of the plant are studied as to their special functions and their relation to envoirment. The stem, root, leaf, flower, etc., are carefully examined and their ecological relations pointed out.

The Forest Academy is very favorably located for the field study of Plant Ecology, as a great variety of plant life conditions may be found in the immediate vicinity of the school. Therefore, students are able to work in the adjoining fields and forests, which is a decided advantage over the studying of plant life processes in the laboratory.

15. ZOOLOGY.

3 Credit Hours — *Second Term, Sophomore Year.*

General Zoology.

In this course a general survey is made of the animal kingdom from the Protozoa to the Chordata. In the laboratory each student dissects an animal typical of each phylum and makes drawings of the parts observed. Hegner's *College Zoology* is the text used.

16. ZOOLOGY.

2 Credit Hours — *First Term, Junior Year.*

A review of cordata including Mammals and birds indigenous to Pennsylvania.

17. BOTANY.

2 Credit Hours — *First Term, Junior Year.*

Wood Morphology.

A study of the microscopic structural features of wood. Representative type specimens of the conifers and broad leaved trees are studied in detail with compound miscroscopes in order to determine the occurrence, form and structure of the wood elements. All structural features which are of value in distinguishing the different woods are studied under the simple and compound microscope from cross, radial and tangential sections of the different woods. Record's *Identification of the Economic Woods of the United States* and Jeffrey's *The Anatomy of Woody Plants* are used as texts and reference.

18. CHEMISTRY.

3 Credit Hours — *First Term, Freshman Year.*

This course comprises a study of the metals and non-metals. Lectures and recitations are correlated with laboratory experiments to illustrate fundamental facts and general principles. The acquisition of a chemical vocabulary and of initiative and skill in making observations receives special emphasis. Kahlenberg's *Outlines of Chemistry* is used.

19. CHEMISTRY.

3 Credit Hours — *Second Term, Freshman Year.*

The main outlines and general methods of qualitative and quantitative analysis are studied. Stress is laid upon the development of accuracy and efficiency in method and technique, rather than upon the mere acquisition of facts.

20. CHEMISTRY.

2 Credit Hours — *First Term, Sophomore Year.*

The general outlines of organic chemistry as a whole are first studied. Then the methods of deriving and manufacturing the chemical products of forest origin are presented. Reports to the class on special subjects assigned for experiment or investigation are required from time to time. Hart's *Organic Chemistry* is the text used. The reading of Slosson's *Creative Chemistry* is required.

21. TRIGONOMETRY.

4 Credit Hours — *First Term, Freshman Year.*

The course covers trigonometric analysis, right and oblique triangles, and the use of logarithms and tables. Special stress is laid upon the solution of practical problems with accuracy and speed. Right, quadrantal and oblique sperical triangles are covered briefly, em-

phasizing the practical application of spherical trigonometry. Philips and Strong's *Elements of Trigonometry* is followed as a text, but problems and illustrations from other authorities are frequently taken up in class and special assignment.

22. DRAWING.

1 Credit Hour — *Second Term, Freshman Year.*

The use of drawing instruments. Lettering. Tracing. Blueprinting.

Projections. Drawing of simple construction.

The plotting of compass surveys in coordination with Surveying.

23. PLANE SURVEYING.

1 Credit Hour — *Second Term, Freshman Year.*

An elementary course intended to clear the way for advance surveying and improve the students sense of position and direction in the woods. It gives the student a better grounding for sample plots, strip surveys, timber cruising and the use of mensuration instruments in the summer term, and second year course in Forest Mensuration. Linear measurement-pacing, chain, tape: compass surveying— — — latitudes and departures, error of closure and area calculation: Simple traverse-board sketching: Use of aneroid: Use of Abney level.

24. PLANE SURVEYING.

3 Credit Hours — *First Term, Sophomore Year.*

Advanced work. *The engineers transit*—traverses by direct angle, deflection angle, azimuth methods: Stadia surveying: Meridan determination: Gradienter attachment for road grades: Trigonometric levelling: Transit for spirit levelling:

The Wye level—in precise leveliing, differential levelling, setting stakes to grade for road, drain and construction work.

Plane table with telescopic alidade, three point determination, the making of a plane table map.

Testing and adjustment of instruments. Plotting of field notes, maps and profiles.

26. TOPOGRAPHIC SURVEYING.

2 Credit Hours — *Second Term, Sophomore Year.*

(a) Rough rapid survey, compass, pacing, aneroid: Principle of contours.

(b) Accurate mapping. Triangulation-base line measurement; determination of angles with methods for repetition and series: Correllation of different instruments for different parts of a survey.

26. FOREST MAP.

2 Credit Hours — *Summer Session, Sophomore Year.*

The construction of a contour map of 2500 acres of mountain land—field work—drafting—tracing and blue printing. Practice for Surveying 25.

27. TRUCKS AND MECHANICS.

2 Credit Hours — *First Term, Freshman Year.*

This course aims to give the student a practical working knowledge of automobile and truck driving and maintenance through work in class room, garage, and on the road. Steam engine, sawmill equipment, and telephone work, such as might be encountered in the forest are taken up. Frazer & Jones' *Motor Vehicles and their Engines* is used as reference.

28. SHOP.

1 Credit Hour — *Second Term, Freshman Year.*

This course aims to give the student a working knowledge of the tools used in rough construction of wood and metal. Active shop work in making of tenons and joints for wood work, and of important phases of black-smithing will be covered. A large well lighted work shop, well equipped with the necessary tools will be used for instruction.

29. PHYSICS.

3 Credit Hours — *Second Term, Freshman Year.*

This course includes a study by observation and experiment of the principal phenomena of matter and energy together with an application of general principles to the solution of forest problems. Kimball's *College Physics* is the text used.

30. PHYSICS.

3 Credit Hours — *First Term, Sophomore Year.*

Continuation of course 29.

31. METEOROLOGY.

2 Credit Hours — *First Term, Sophomore Year.*

This course introduces the student to scientific methods used in determination of the various climatic factors and their relation to weather changes. United States weather maps are received daily and methods of forecasting explained. Milham's *Meteorology* is used as text.

32. GEOLOGY.

3 Credit Hours — *First Term, Sophomore Year.*

A course designed to give an introduction to general geologic principles. Attention is paid particularly to the dynamical, structural, and historical geology of Pennsylvania with reference to the processes involved in the development of the present topography and the soil provinces of the state. Field excursions based on the use of topographic maps are made from time to time. Chamberlin and Salisbury's *College Geology* is used.

33. SOILS.

3 Credit Hours — *First Term, Sophomore Year.*

This course aims to develop by observation and experiment the principles governing the properties and management of field and forest soils. Field work is required to illustrate soil survey methods, and to harmonize theory with practice in application of the conclusions derived from laboratory experiments. Students are required to report on the analysis of one soil sample brought from a typical locality near their homes. *Soils* by Lyon, Fippin, and Buckman is the text used.

34. GERMAN.

2 Credit Hours — *First Term, Freshman Year.*

A course comprising a careful drill in pronunciation and the principles of German Grammar. Selected German texts and Thomas' *Practical German* Grammar are used.

35. GERMAN.

2 Credit Hours — *Second Term, Freshman Year.*

Continuation of (34) German with selected texts.

36. GERMAN.

2 Credit Hours — *First Term, Sophomore Year.*

Course in Scientific German, Gore's *German Science Reader* and selected texts.

37. GERMAN.

2 Credit Hours — *Second Term, Sophomore Year.*

Continuation of preceding course with selected forestry texts used Hausrath's *Der Deutsche Wald* is the first text used.

Class of 1921.

Name.	*Residence.*
Bradley, Tom Oswald,	Mercersburg, Pa.
Brouse, Edgar Frederick,	Boalsburg, Pa.
Clepper, Henry Edward,	542 Locust St., Columbia, Pa.
Houpt, Richard Ritchey,	Mercersburg, Pa.
Kreamer, George Parfeit,	574 Carey Ave., Wilkes-Barre, Pa.
Kutz, Donald Bentley,	231 Franklin St., Reading, Pa.
Lefkof, Emil Alfred,	422 N. Main St., Wilkes-Barre, Pa.
Mosch, Walter Fred,	Coudersport, Pa.
Nicholas, Herbert Murray,	538 E. Market St., York, Pa.
Shaw, Thomas Edward,	207 W. 7th St., Chester, Pa.
Swingler, William Sherman,	544 Cherry St., Columbia, Pa.
Shirey, Thaddeus Irwin,	212 S. 16th St., Reading, Pa.
Taber, William Stone,	725 Wilson St., Williamsport, Pa.

Class of 1922.

August, William A.,	1223 E. Pine St., Mahanoy City, Pa.
Frontz, Leroy,	Allenwood, Pa.
Lott, Hugh Carlin,	Springville, Pa.
Shulley, Frederick,	1650 Muhlenberg St., Reading, Pa.
Somers, Gayle Hamilton,	Renton, Pa.
Stott, Calvin Brill,	1608 Perkiomen St., Reading, Pa.
Yehl, Richard Kuhns,	1531 Hanover Ave., Allentown, Pa.

Class of 1924. (Four Year Course)

Dunmire, Daniel Edward,	240 Unity St., Greensburg, Pa.
Feuchsel, Charles F.,	5213 Baltimore Ave., Phila., Pa.
Genaux, Charles M.,	Shinglehouse, Pa.
Geltz, Charles G.,	810 Ridge Ave., McKeesport, Pa.
Holtz, Irenus B.,	Ashville, Pa.
Moll, Wilford P.,	East Greenville, Pa.
Norris, Thomas G.,	Philipsburg, Pa.
Schaeffer, Charles H.,	419 W. King St., Lancaster, Pa.
Schlatter, Ernest J.,	Tunkhannock, Pa.
Schoen, Paul W.,	1127 Division St., Scranton, Pa.

Class of 1925.

Anderson, Hartley Kirtland,	4630 5th Ave., Pittsburgh, Pa.
Bowlby, Irving Stickles,	324 S. River St., Wilkes-Barre, Pa.
Carnegie, William,	1569 Earl St., Wilkinsburg, Pa.
Eby, Harry G.,	Washington St., Chambersburg, Pa.
Forsythe, Howard Yost,	213 Lockhart St., Sayre, Pa.
Frampton, Samuel R.,	1127 East St., Wilkinsburg, Pa.

Feeman, Abraham, ...109 Canal St., Lebanon, Pa.
Hughes, Charles Collins, ...Collegeville, Pa.
Kerns, Chester Merrill, ...220 Allegheny St., Jersey Shore, Pa.
Le Duc, Edmond, ...Mont Alto, Pa.
McNees, Wayne Anthony, ...616 9th Ave., New Brighton, Pa.
Nixon, Robert Brighton, ...2160 N. 19th St., Philadelphia, Pa.
Pardoe, Homer W., ...532 Market St., Williamsport, Pa.
Sebring, Harold Martin, ...62 S. Sherman Ave., Allentown, Pa.
Smith, Harry Frederick, ...416 Main St., Kingston, Pa.
Smith, Ralph Wilson, ...8 Stout St., Pittston, Pa.
Sipe, Francis Henry, ...Somerset, Pa.
Somers, Frances Wilkinson, ...Renton, Pa.
Stauffer, Jacob Martin, ...43 S. 5th Ave., Coatesville, Pa.
Wilcox, Ralph F., ...New Albany, Pa.
Wood, Cyrus G., ...Mont Alto, Pa.
Woods, Ignatius Leroy, ...Marienville, Pa.

GUIDE TO FORESTRY

BOOK ONE

BY

JOSEPH S. ILLICK

Bulletin 26

PENNSYLVANIA DEPARTMENT OF FORESTRY
R. Y. Stuart, Commissioner

FOREST GUIDES

The Pennsylvania Department of Forestry recognizes that the Boy Scout movement is one of the most valuable agencies in the State for the elimination of FOREST FIRE. With the approval of National Boy Scout Headquarters, the Department has adopted the official designation, Pennsylvania Forest Guides, to be conferred on any registered member of the Boy Scouts of America, resident of Pennsylvania, who signs a Pennsylvania Forest Guide pledge card to be supplied by the Department of Forestry, Harrisburg, Pa.

Each Pennsylvania Forest Guide will be supplied with a bronze button and a book "GUIDE TO FORESTRY" after he has signed the pledge card. Scoutmasters and other Scout officials signing the pledge card will be given white metal "Pioneer Forest Guide" buttons.

Each Pennsylvania Forest Guide or Pioneer Guide who has been available for service for a whole year in the fight against FOREST FIRE, and responded to all calls for such service, can, upon the recommendation of his Scoutmaster, exchange his Pennsylvania Forest Guide button for a Forest Guide badge at the office of the District Forester.

The Department of Forestry also offers 100 gold medals annually to Boy Scouts for special meritorious service in combating FOREST FIRE in Pennsylvania. It is hoped that all registered Scouts will take advantage of this offer, and help to protect the forests from FOREST FIRE—EVERY MAN'S ENEMY.

Boys who do not belong to the Boy Scout organization can become **AMERICAN FORESTRY GUIDES** by applying to the American Forestry Guide Headquarters, 431 Elm Street, Reading, Pa.

FOREST GUIDE OF PENNSYLVANIA

TO WHOM IT MAY CONCERN:—This is to certify that the bearer hereof is a registered member of the Boy Scouts of America, and having signed the Forest Guide pledge, is authorized to wear the Forest Guide button. The citizens of Pennsylvania are hereby requested to extend all possible courtesies to him as a Forest Guide.

R. Y. STUART, Commissioner of Forestry.

....

(Signature of Scoutmaster) *(Authorized representative of Local Council)*

Date .....

FOREST GUIDE PLEDGE

Believing as a Boy Scout that every citizen should endeavor to see that our Forests, together with their Wild Life and Plant Life, should be protected and conserved for our common good, I do hereby pledge myself to do nothing willfully or carelessly to injure any Forest Tree, Wild Plant, Bird, or harmless Animal, to do all in my power to protect and conserve the same, to urge others to do likewise, to prevent and extinguish forest fires.

Signature.....
(Scout)

Troop No. .... **of**.....**Penna.**

AN APPRECIATION OF SCOUTING

Scouting is worth while. It makes real boys and girls and then turns them into real men and women. A good Scout makes a good American. A good American makes a good citizen, and good American citizens make America the first Nation in the world.

Scouting is good fun, but it is a lot more than that. It is the best kind of preparation for whatever life is to bring in the days ahead. A good Scout is seldom or never caught unprepared, and a man or a woman who has grown up out of a boy or girl scout is always ready to meet the present and future with head up, eyes front, and shoulders back.

There is a lot more in the United States than can be seen from a street car. It is the land, and the boys and men, girls and women who know the land, who make the strength of this and any other country. Not the least valuable thing about scouting is that it teaches the city boy and girl to know the country, and the country boy and girl to know the country better than he or she otherwise would.

The forest is not only the mother of the fountain, but the mother of men as well. Our ancestors lived in the forest. We live with the help of the forest. Wood is still the most useful of all materials, and will continue to be for many years after you and I have passed to our reward.

Boys and girls who know the out-of-doors render services of great value to their Nation and State by understanding the forest and taking part in its protection. It is just as important for people to think rightly about preventing forest fires as it is for them to think rightly about preventing fires in a town, or any other similar calamity. When you help to make people respect and appreciate the forest you help in its protection.

An understanding of the forest and of the conservation of all natural resources is growing rapidly among Scouts. In two years the number of badges awarded to boy scouts in forestry grew from 153 to 513. I would like to see still more awarded in Pennsylvania.

This booklet is prepared primarily for the Boy Scouts of America, Forest Guides, American Forestry Guides, Wood Craft League, Knights of St. George Cadets, Camp Fire Girls, Girl Guides, and other junior outdoor organizations in Pennsylvania. I hope that every boy and girl who gets this book will not only study its pages but take it into the forest, compare what is here printed with what they find out-of-doors, and so get to know the forest which is the home of scouting and woodcraft and a great necessity for the welfare of the human race.

GIFFORD PINCHOT

PENNSYLVANIA DEPARTMENT OF FORESTY

STATE FOREST COMMISSION

R. Y. Stuart, Commissioner of Forestry.

Edward Bailey.

Henry W. Shoemaker.

Mrs. John L. Lawrence.
(Mary Flynn Lawrence.)

Henry S. Drinker.

Lewis E. Staley, Chief, Bureau of Operation.

George H. Wirt, Chief, Bureau of Protection.

John W. Keller, Chief, Bureau of Silviculture.

Alfred E. Rupp, Chief, Bureau of Lands.

Joseph S. Illick, Chief, Office of Research.

W. Erdman Montgomery, Chief, Office of Maintenance.

A. O. Vorse, Chief, Office of Information.

E. A. Ziegler, Director, State Forest Academy.

GUIDE TO FORESTRY

Book One

By JOSEPH S. ILLICK

CONTENTS

	Page		Page
Introduction,	5	How to fight forest fires,	16
The original forest,	6	Other things to do,	18
The march of forest destruction,	7	Why plant forest trees,	19
The present forest situation,	8	Why become acquainted with trees,	21
Forest area of Pennsylvania,	9	How to become acquainted with trees,	22
What a forest is,	11	Some representative Pennsylvania forest trees,	23
What forestry is,	13	Where to study trees,	55
What is wrong with our forests,	13	Where the State Forests are located,	56
How forest fires start,	14	You are welcome on the State Forests,	56
What forest fires do,	15	Facts about Pennsylvania State forests,	57
Why prevent forest fires,	15		
How to prevent forest fires,	16		

The mere mention of the name Robin Hood among a group of boys kindles a desire to go to the woods. There is only one way to satisfy this desire which is inborn in almost every American boy, and that is for him to get ready and go out along the beaten and unbeaten paths of the forests, and there fill up on the many good things which our forests hold in store for us.

Where is the boy who has studied American History and not been inspired by the adventures and heroic deeds of Daniel Boone, Andrew Jackson, Abraham Lincoln, and Theodore Roosevelt. It is the lives of these men that appealed to every boy. Becoming woodswise, learning by doing, being brave, chivalrous, resourceful and leading a simple, clean, and useful life are worthy qualities which should be developed in all the boys of our great Commonwealth.

There is no better place than in the forests for boys and girls to frolic and receive their instruction. Most of their doings relate to the forest, and the whole scheme of their instruction has its setting in the woods. The forest environment offers the best place to seek adventure, to become hard and handy, to think quietly, to identify rocks, to study trees, and learn the need for forestry.

The original forests, which formed the background for the unusual deeds of the early pioneers, are now practically all gone in Pennsylvania. Only a few small and widely scattered patches remain, and these are beginning to show man-made marks of travel and work. A short description of the original forest follows. It is written with the hope that it will help the boys and girls of today realize more fully the real thrill of pioneer life, and picture the trials and toils of Daniel Boone and other early explorers.

THE ORIGINAL FOREST

The early American pioneers were confronted on all sides with forests. There seemed to be no end to the woods in those days. They extended practically unbroken from the Atlantic Ocean to the prairies beyond the Mississippi River. They also covered most of the Rocky Mountains and occupied a wide strip on the Pacific Coast. In the aggregate the original forests covered 822,000,000 acres, that is, an area about 30 times the size of the State of Pennsylvania.

The vast extent of the original forests was only one of their characteristics. They contained a large variety of trees which attained a great age, reached a large size, and produced enormous quantities of the choicest lumber ever found on the face of the earth. Nowhere was an equal area ever found which contained such vast quantities of forest products suitable for the needs of man.

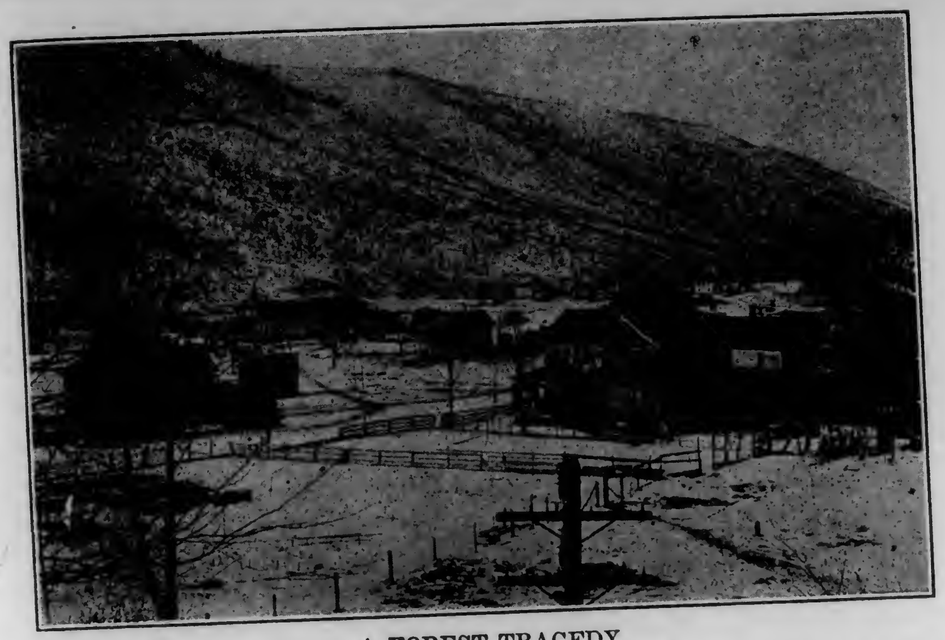
Nature made Pennsylvania a great and prosperous State. No phase of her progress is more striking than that which relates to her forests. The entire State with the exception of a few natural meadows and a small number of rough mountain tops was covered with a dense forest growth. No better and more valuable stands of timber could be found in any of the eastern states.

The word Pennsylvania means Penn's woods. The name was derived from the first proprietor of the province and the dense and heavy forests which practically covered all her soil. It required many centuries of Nature's best efforts to produce these matchless and supposedly endless miles of primeval forest, which the first settlers found upon all the hills and in every valley of our great Commonwealth.

The primeval forests, untouched by the axe or saw of man, were a wonderful environment for the pioneer boy. His was not an easy environment, but one full of rich and original experiences. It made him hard, handy and healthy. It brought out the best that was in him. But, we of to-day must not forget that much was required of him. His tasks were hard. He had big jobs to do, the finishing of

THIS IS THE FOREST PRIMEVAL.

Pennsylvania originally had more than 28,000,000 acres of original forest, of which less than 25,000 acres now remain.



A FOREST TRAGEDY.

The forests of big trees have been cut, the land is idle, and the inhabitants of this once properous lumbering town are nearly all gone. In its prime the town of Cross Fork, Potter County, had over two thousand inhabitants; now less than twenty people live there.

Photo by J. S. Illick.

THE MARCH OF FOREST DESTRUCTION.

The lumberman fells trees, then forest fires rage, and thereafter only acres of desolation remain.

which required many days of hard work in some remote clearing in the woods where human companions were unknown and travelers rarely ventured. To be a pioneer boy means much more than being able to help fell trees, build log cabins, and work in the small family clearings.

The pioneer boy was assigned to outpost positions on the danger line about the forest border. He helped to provide for his family, and protect his friends from numerous and treacherous enemies. His duties required that he become acquainted with the fundamentals of woodcraft. He learned to know the animals of the forest, and studied the ways of the wild folks. He became acquainted with the trees and other plants of the forest. He knew the trees which produced valuable wood, and could recognize the medicinal herbs. The pioneer boy was indeed rich, not in money but in knowledge and ability. He knew his environment and could do things. He was a keen observer, fearless explorer, and a cheerful doer of many good and useful deeds.

Every boy of to-day can find some characteristics or virtues of the pioneer boy of the early days which are worth striving for. There is only one way to get these virtues, and that is the best way. Go out in the glorious and boundless out-of-doors, do the things the pioneer boy did, and learn your lessons as he learned his.

THE MARCH OF FOREST DESTRUCTION

Pennsylvania has a land area of 28,692,480 acres. Almost every acre was covered originally with an excellent forest growth. But a great change has taken place since the days when the early settlers began building their cabins and clearing their fields. To-day only a few small patches of the original forest remain. Where once stood heavy stands of the choicest white pine, hemlock, cherry, oak and other important timber trees, there exist now only endless stretches of barren mountain land. The questions which naturally follow are: What brought about this rapid change? Who were the chief agents of forest destruction?

There were a number of agents of destruction, but man played the leading role. He felled the monarchs of the forest, operated sawmills, and started forest fires. Even before Penn arrived in 1682, the Dutch and Swedes had sawmills on the "South River" as the Delaware was then known. But they were few in number and did not cut much timber. The date when the first sawmills began operating in some of the counties of the State is given in the following table:

COUNTY	YEAR
Philadelphia	1662
Franklin	1732
Berks	1735
Lycoming	1773
Allegheny	1776
Huntingdon	1786
Wyoming	1793
Warren	1800
Clarion	1805
Elk	1825

It was not until 1838 that the first sawmill was erected in Williamsport. This was the actual beginning of the great lumber industry of Pennsylvania, which was at its best between 1870 and 1890. In 1850 the lumber output of Pennsylvania was surpassed by only one state—New York—and in 1860 the Keystone State stood at the very top. She maintained a rank of first or second until 1890, when she took third place. Fourth place was given her in 1900, and by 1918 she had dropped down to the twentieth place, which position she is still holding.

Pennsylvania's fall as a timber producing state was rapid. It could not have been otherwise, for her forests were gone. Just thirteen years ago as much wood was cut in Pennsylvania as her citizens and industries used. Now the annual cut of wood is only one-third as much as we consume, and what is far more significant, our forests are growing only about one-tenth as much lumber as we use.

The great and glorious lumber industry flourished for a short while in Pennsylvania. It brought much business to the State, but left a big blot on its otherwise wonderful and prosperous record —**THE PENNSYLVANIA DESERT.** There are in our State to-day six million acres of mountain land, which can produce only one crop, and that is a forest crop. This area is too rough and rocky for the plow; but if handled properly will provide a continuous flow of valuable and necessary forest products.

We do not want to keep this unproductive desert. To do so would be entirely wrong and selfish, and show poor foresight. It becomes us to show our worth and good sense by treating these six million acres in such a way that a full crop of necessary forest products will flow from them continuously.

THE PRESENT FOREST SITUATION

We do not have enough wood to satisfy fully the present demands. It is becoming scarcer each year and the prices are rising rapidly. Wood will forever be a human need. It is used in the in-

dustries, the home, and the fields. It is an element of human necessity from the cradle to the coffin. Next to food and clothing it is the most indispensable product of nature. We are now in the early stages of a timber shortage, which we must not allow to grow worse, for without wood there can be no agriculture, no manufacture, no commerce.

Most of the work of reclaiming Pennsylvania's Desert wili fall to young people. They are the ones who look forward and want to set things aright. It is they who are building for the future, and concerned with the problems which require a long time to complete.

The boys and girls of Pennsylvania can render a great and lasting service by helping in the restoration of a forest growth upon Pennsylvania's Desert. They can at least do a part of this fine piece of work. In fact, they have started upon the job already, are taking it seriously, and making commendable progress. Boys are helping to extinguish forest fires in every part of the State. In some cases they put out fires without any help. They have also reported many fires to forest officers. A troop of Boy Scouts fought a fire strenuously for one day and night and conquered it completely. It will ever be to their credit for having worked so hard and accomplished so much. The Scouts have also planted many trees, cleaned up the forest of weeds and debris, improved springs, built trails, and cared for birds and other wild animals. They have done much good, which is being appreciated and will live long after them.

But in order that every boy and girl may do his and her part well, and probably better than would otherwise have been possible, this little booklet has been prepared. It does not aim to tell all about the forests or point out all good forestry practices, but its purpose is rather to impress our young folks with a few of the most important things which they should know, and do in order that they may help protect and improve our forests.

FOREST AREA OF PENNSYLVANIA

Pennsylvania was originally one of the best, if not the very best, wooded state in the eastern half of our country. The total land area of Pennsylvania is usually given as 28,692,480 acres. Practically the entire state, with the exception of a few natural meadows and several rough mountain tops, was originally covered with trees.

The opening of agricultural lands, lumbering operations, forest fires, and other agents of forest destruction, have reduced this acreage considerably. The following table gives the present forest area of Pennsylvania by counties:

COUNTY	TOTAL FOREST AREA (ACRES)	COUNTY	TOTAL FOREST AREA (ACRES)
Adams,	99,262	Lackawanna.	110,020
Allegheny,	109,200	Lancaster,	99,177
Armstrong.	127,913	Lawrence,	48,951
Beaver,	77,362	Lebanon,	41,650
Bedford,	276,000	Lehigh,	47,500
Berks,	115,096	Luzerne,	380,827
Blair,	136,704	Lycoming,	489,855
Bradford,	304,416	McKean,	565,000
Bucks,	63,304	Mercer,	106,650
Butler,	105,565	Mifflin,	160,251
Cambria,	256,972	Monroe,	210,000
Cameron,	197,500	Montgomery,	47,200
Carbon,	124,800	Montour,	33,280
Centre,	496,013	Northampton,	39,700
Chester,	88,676	Northumberland,	92,000
Clarion,	153,000	Perry,	184,039
Clearfield,	500,000	Philadelphia.	4,500
Clinton,	453,608	Pike,	261,118
Columbia,	137,952	Potter,	509,921
Crawford,	210,000	Schuylkill.	325,000
Cumberland.	97,423	Snyder,	67,000
Dauphin,	97,603	Somerset,	399,960
Delaware,	15,000	Sullivan,	210,000
Elk,	417,000	Susquehanna.	180,000
Erie,	80,000	Tioga,	375,440
Fayette,	335,000	Union,	98,440
Forest,	233,648	Venango,	176,000
Franklin,	153,303	Warren,	395,486
Fulton,	140,000	Washington.	76,861
Greene,	89,420	Wayne,	283,707
Huntingdon.	355,000	Westmoreland.	215,450
Indiana,	176,000	Wyoming.	139,744
Jefferson,	221,000	York,	119,630
Juniata.	108,500		
		Total Forest Area	13,046,557

A study of the above table shows that seven adjoining counties, located in the north-central part of the State, comprise more than one-fourth of the total forest area of the State. These counties are McKean, Potter, Clearfield, Centre, Lycoming, Clinton, and Elk. It is quite significant that while the seven counties comprise more than one-fourth of the total forest area, they make up less than one-twenty-third of the State's total population. The county having the largest forest area is McKean. It has a total land area of 631,680 acres of which 565,000 acres, or 89.4%, is forested.

There are six counties in the State of Pennsylvania that have more than 75% of their total land area in forests. They are McKean, Forest, Elk, Clinton, Cameron, and Pike. It is significant that twenty-six of the sixty-seven counties of Pennsylvania have more than 50% of their total land area in forests, and that 45.5% of the total land area of the State is forest land.

There are in Pennsylvania 13,046,557 acres of forest land and 8,720,017 inhabitants. This means that there are one and one-half acres of forest land for each inhabitant of the Keystone State. A study of the forest area and population of each county shows a wide variation. There are in the State twenty counties that have less

than one acre of forest land for each inhabitant; twenty-four counties that have from one to ten acres of forest land to each inhabitant; ten counties with from ten to fifteen acres of forest land to each inhabitant; and only three counties that have more than twenty-five acres of forest land for each inhabitant.

The forest area per capita ranges from .0025 acres in Philadelphia County to 38.3 acres in Pike County. The counties having the largest forest acreage per capita are:

COUNTY	FOREST AREA PER CAPITA (Acres)
Pike,	38.3
Cameron,	31.4
Forest,	31.0
Potter,	24.2
Sullivan,	22.1

Some of the counties having the smallest forest area per Capita are:

COUNTY	FOREST AREA PER CAPITA (Acres)
Philadelphia,	.0025
Delaware,	.09
Montgomery,	.2
Lehigh,	.3
Northampton,	.3
Washington,	.4
Lackawanna,	.4
Erie,	.5

The forest land of Pennsylvania may be placed in the following classes:

	AREA (Acres)
State forest land, ...	1,126,237
Farm woodlots, ...	4,043,902
Outside of State Forests and farm woodlots, ...	7,876,418
Total, ...	13,046,557

WHAT A FOREST IS

A forest is a complex community of living things. It is more than a mere collection of trees, for associated with the trees are many

other plants and animals, all of which live in close relationship with one another.

There is a right and a wrong way for boys and girls to find out what a forest really is. Many hours may be spent in schoolrooms, libraries, and parlors studing about the forest and its inhabitants. Such a method has some good points, but there is a better way. The right way to become acquainted with the inhabitants of forests consists in getting ready, going out, hiking right into them and there beginning a first-hand acquaintance with the many and interesting members of which it is made up.

Do not plan to become acquainted with all the forest inhabitants on the first trip into the woods for there are too many of them. Just as it is impossible to become acquainted with all the inhabitants of a city in a single day, so it is beyond the realm of the possible to learn to know all of the members of the forest on a single hike.

A good plan for the first hike to the forest is to list or make a census of all the different groups or classes of plants and animals which you may observe, that is, make no special attempt to name the individuals. This may be done by making a table of two columns, the one with the heading **Plants** and the other **Animals**, and listing under each all the living things observed. Only two columns are required, for all living things are either plants or animals. The table may be made up in the following manner:

PLANTS	ANIMALS
1. Trees	1. Deer
2. Shrubs	2. Squirrels
3. Ferns	3. Rabbits
4. Mosses, etc.	4. Birds, etc.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

Such an exercise will show that while the trees are the most conspicuous and the most important members of the forest, they are by no means its only inhabitants. Instead, the forest is a complex community of many living things, whose activities are so closely inter-related that the absence of any group may make itself felt on all the remaining members.

Photo by Charles I. Buvinger.

IT IS EVENING. ALL IS WELL WITH THE SCOUTS AND EVERYBODY IS HAPPY.

Photo by Charles I. Buvinger.

A CRUDE BUT COMFORTABLE LEAN-TO SHELTER.

Photo by Charles I. Buvinger.

A LESSON IN NATURE STUDY. BE SURE TO SEE WHAT YOU LOOK AT.

Photo by Charles I. Buvinger.

A TRIO OF TREE LOVERS.

They have named and identified all the different trees about their camp.

Photo by Charles I. Buvinger.

IT IS TRUE. ONE TREE MAY MAKE A MILLION MATCHES, BUT ONE MATCH MAY BURN A MILLION TREES.

WHAT FORESTRY IS

Forestry is the art of handling forest land in such a way that it will be of the greatest service to man. It is no field for selfish effort and has no place for a greedy goal. Good forestry considers the wants of future generations as well as our present needs. It recommends the wise use of all forest products now on hand, and insists that a growth of valuable forest trees be maintained continuously on every acre of forest land. Idle acres; barren slopes, areas of desolation, and unproductive land are objects to be overcome and improved.

WHAT IS WRONG WITH OUR FORESTS

That our forests are in urgent need of improvement is no longer a question. Many of them are unattractive; fire-scarred snags, exposed boulders, and bare soil being among their most striking characteristics. Most of them are unsanitary, for they are filled with debris, dirt, half rotten trunks, stumps, and insect infested stuff. All of our forests are producing fewer products than they are capable of turning out. Furthermore, there appears to be no order in them, for they have developed without any attention or care.

A general study of prevailing forest conditions shows that the forests of to-day fall short of being satisfactory in at least four important ways:

1. They do not produce enough good wood.
2. They are not attractive in appearance.
3. They are positively unclean.
4. There is no order in them.

The boys and girls cannot do all the things or carry on all the operations which are necessary to bring about the desired improvements, but there are a number of lines of work which they can and should do; and it is equally important to know that there are other things that should not be done. Here are some suggestions:

1. Do not start a forest fire.
2. Tell all your companions about the damage which forest fires do.
3. Report all forest fires to the nearest forest officer.
4. Learn how to fight forest fires, and take a hand in putting them out.
5. Plant forest trees in vacant corners, wasteplaces, abandoned fields, on barren mountain slopes and other unoccupied forest land.
6. Destroy insects which injure and kill forest trees.
7. Destroy rots, blights, and other fungous foes of the forest.
8. Help clean up the forest by using the dead wood found lying on the forest floor.
9. Cut out only undesirable trees and guard the more valuable ones.

HOW FOREST FIRES START

Someone may have told you that lightning causes many forest fires or that spontaneous combustion may furnish the spark which starts the fires on their mission of destruction. In order that we may get at the very bottom of this important subject, and not be misinformed, let us take advantage of the results of a careful study which has been made of the causes of forest fires in Pennsylvania. They may be summarized as follows:

1. Few, if any, forest fires are the result of spontaneous combustion.

2. Lightning does not cause more than 10 or 12 forest fires each year in Pennsylvania, that is, about four-fifths of one per cent. of the total number.

3. Someone's carelessness or neglect causes 99 per cent. of the forest fires which occur each year in Pennsylvania. No matter what the immediate or apparent cause happens to be the real original cause can in almost all cases be traced back to the carelessness or neglect of some person or group of persons. Carelessly constructed or neglected camp fires have started many forest fires. The careless throwing away of a burning match, cigarette, or tobacco among dry leaves has been the cause of some of our worst fires. Sparks from engines start many forest fires, but the real cause is the fact that the smoke stacks were not properly equipped with a satisfactory spark arrester, or a satisfactorily cleared safety strip was not kept on both sides of the road bed. We all believe in clearing up unsightly and unsanitary places, but too often brush burners choose a windy day or forget to take proper precaution so that the fires which they start cannot get away from them. In many instances those in charge of a fire go away for a while, only to return and find that the fire has escaped and is traveling rapidly over an adjoining woodlot or ascending a steep and heavily timbered mountain slope.

4. Be sure the camp fire is out before leaving it. Take no chances, for you can easily tramp it out, smother it with ground, or soak it with water.

5. Be very careful in cleaning up a camp site. Burn the undesirable material when there is little danger of the fire getting beyond control.

6. Be as careful with fire in the forest as in your home, for it is an evil doer if it gets beyond control. Careful boys and girls take no chances with fire in or near the woods, for its actions are treacherous and its destructive power great, if it gets beyond control.

Photo by J. S. Illick.

FOREST FIRE IS EVERY MAN'S ENEMY.

Be sure to look over a forest fire before you tackle it, but do not lose much time. Watching and waiting will not do the work. Locate the "header" and fight it first The "header" is the part of the fire that travels most rapidly. The top of a ridge, or just beyond the top and right in front of the "header" of a fire, is the right place to get busy.

Photo by J. S. Illick.

FOREST FIRES MAY DESTROY HOMES.

There is no end to the damage that forest fires do. In 1918 nearly 400 persons lost their lives in a single forest fire in Minnesota, about 2,000 were more or less seriously burned, and 13,000 rendered homeless.

A MODERN STEEL FOREST FIRE TOWER. IT IS 60 FEET HIGH AND FROM ITS TOP MAY BE VIEWED 500,000 ACRES OF FOREST LAND.

WHAT FOREST FIRES DO.

The first thing that every boy and girl should know about forest fires is the fact that they do absolutely no good. They bring no benefits to mankind, for damage and loss are the results of their work. It would require many pages to discuss fully the loss caused by forest fires. The following outline will show some of the damage which they do:

1. Forest fires destroy the beauty and value of a region.
2. They destroy the animal and plant life of the forests.
3. They destroy the seeds and seedlings which would develop into stately stands of timber.
4. They kill enormous quantities of growing timber.
5. They consume a large amount of felled timber and other forest products stored in forests.
6. They consume the leaf litter and humus on the forest floor.
7. They impoverish the soil to such an extent that its capacity to produce timber is almost negligible. Briefly, they prevent the production of enormous quantities of needed forest products.
8. They have already made a big desert in Pennsylvania. It covers a large part of the mountains of our State.
9. They open the way for the destructive work of insects, fungi, erosion, floods and drought.
10. They sometimes kill live stock, and frequently destroy buildings, crops and fences.
11. They occasionally destroy houses.
12. They even may cause the loss of human lives.

There appears to be no end to the damage which forest fires do. We cannot let them go on. It is our duty to step in right now and fight them to a finish.

WHY PREVENT FOREST FIRES.

There are many reasons why forest fires should be prevented. It would make a list as long as an arm if an attempt were made to name them all, but everyone cannot help but become enthusiastic about preventing forest fires after knowing that:

1. Forest fires are unnecessary. There exists no need for them and they should be stopped.
2. Forest fires benefit no one, except a few selfish people who still have the false notion that forest fires are necessary to insure a crop of Huckleberries.

3. The prevention of forest fires is good business, for they are the curse of our forests. They do only evil. No good comes from them. We endure hardship and suffer great loss because of them.
4. They are responsible for the greatest leak which exists at the present time in our otherwise prosperous Commonwealth.
5. The prevention of forest fires is wise forethought, for they are not only destroying annually an enormous quantity of wood, but also prevent an inestimable amount of wood from growing. It is our duty to stop them now, because of the damage they do, and the hardships which will bear down upon future generations through a shortage of forest products.

HOW TO PREVENT FOREST FIRES.

It seems to follow from the study of the causes of forest fires that the best way to prevent them is to have every inhabitant and every visitor of our Commonwealth be careful and thoughtful about the use of fire in all forms and at all times. The following suggestions should be helpful in out-of-door activities:

1. Be sure you do not throw away a lighted match or any other burning material while walking through, resting, or camping within the woods.
2. Clear the ground of all inflammable material before building a camp fire. If possible, dig a small pit in a clear area, and surround it at least on three sides with a wall of stones. This makes an ideal and safe fire place.
3. Never build a big fire. It is neither necessary nor safe.
4. Of course, most boys do not smoke, but if you are allowed to smoke or choose to "steal a smoke," be very careful in disposing of the burning tobacco, cigar, or cigarette. Many a forest fire was started by a carelessly disposed of cigar or cigarette, and the thoughtless throwing away of burning tobacco.

HOW TO FIGHT FOREST FIRES.

Someone has said that the best way to fight forest fires is to prevent them from starting. That is good advice and a fine idea, but some fires will start and must be fought. The putting out of a forest fire is a real fight. It is one of the severest contests a group of young men can engage in. Forest fires are a difficult enemy to overcome, for their advances are usually fierce and uncertain.

In order to overcome them quickly the fighters must take heart, and then "dig in" and use their heads, hands and feet with all their might. By so doing they will be able to conquer the most formidable foe of the forest.

The best results will be obtained if the fighting force is well equipped, properly organized, and so trained that every member understands the most important rules of the business. A schedule follows which points out some of the most imporant things which should be done in case of forest fires.

1. Always be on the watch for forest fires, especially during the spring and fall when they are apt to occur and in regions where they happen frequently.
2. The first thing to do, if you are at or near a fire when it starts, and it is not too large, is to try to put it out.
3. The first thing to do, if you are at a distance from the fire, or if it is large in size and burning rapidly, is to notify the nearest forest officer, who may be a Forester, Forest Ranger, Forest Fire Warden or Game Warden.
4. The second thing to do is to get together a crew of fire fighters.
5. See to it that the fighters are properly equipped.
6. Get the fighters to the fire as soon as possible. The secret of success in fighting forest fires is to knock, kick or otherwise get them out in the first round, for they become larger and stronger the longer you allow them to go ahead.
7. As you approach a fire look it over and proceed to take the best position to attack it. Always tackle "the header" first, that is the part of the fire which is traveling fastest.
8. Upon reaching the fire, offer your service to the forest officer in charge. If no forest officer is present, organize your men and tackle the fire without delay. Lose as little time as possible in discussing the situation.
9. A slow fire may be stopped by beating it out, but in cases where fires are progressing very rapidly, it is best to clear a line about two feet wide of all inflammable material some distance ahead of the fire. If the fire is not advancing too fast it will stop when it reaches this cleared line, but if a strong wind is blowing it is very apt to jump over the cleared line and proceed onward doing destructive work. In the case of rapidly advancing fires it is recommendable to start a "Back Fire" on the side of the cleared line towards the original fire, and when they meet, both will die out for want of inflammable material. A "Back Fire" improperly placed or poorly timed may do more damage than good. Therefore, no "Back Fire" should be started by boys unless a forest officer, or another person who has had experience in fighting forest fires, is at hand to direct the fight.
10. One of the most responsible positions on a fire line is that of the "guards" who control the back fire and see to it that the fire does not jump over the fire line.
11. Do not expect every established fire line to hold, for you will sometimes be compelled to fall back, reorganize the fighters and begin to battle from a new and more advantageous position.
12. Do not give up until you have won the fight. Remember that the fight is not really won until the last spark is out. Therefore, do not leave a fire immediately after the flames have been subdued, but patrol the lines and see to it that it does not break out anew and go on another spree of destruction.

OTHER THINGS TO DO.

The stopping of forest fires will do much to rebuild our devastated forests, but there are other things which must also be done in order to place them in a satisfactory condition. These important tasks should go hand in hand with or follow right after protection. Some of these essential things are:

1. Securing a new growth of valuable trees as quickly as possible on every acre of devastated land within the State. We cannot afford to leave so many acres of mountain land remain idle. It does not pay to delay. Right now is the time to see to it that all unproductive areas of forest land are so stocked with trees that they will begin to produce a valuable forest crop.
2. Another thing to do is to give preference to the important forest trees and eliminate as rapidly as possible the undesirable kinds. There are over 100 different kind of trees and about 200 different kind of shrubs native to Pennsylvania. Nature does not show any preference for the important timber trees in the early stage of reforestation. As a rule, many different kind of trees come up after forest fires and lumbering operations, and in the struggle for an existence the inferior ones often win out. If the job of restocking our forest land is left to nature entirely, a great deal of ground will be occupied by worthless trees. It is our business, therefore, to learn to know the best trees, and then help them overcome inferior ones such as scrub oak, fire cherry, trembling aspen, sumachs and other similar weed trees. While in camp boys and girls should show their appreciation of the land owner by helping him improve the composition of his forest by cutting out the inferior trees and thus help those of better quality.
3. A third thing which is essential to rebuilding our forests properly is the removal from the forests of all trees of

Courtesy of the U. S. Forest Service.

BE SURE THAT THE CAMP FIRE IS OUT BEFORE YOU LEAVE.

A COMFORTABLE CAMP ON THE MOSHANNON STATE FOREST IN PENNSYLVANIA.

There are 563 permanent camp sites under lease on the State Forest of Pennsylvania, and during 1921 at least 80,000 people used the State Forests for camping and recreation purposes.

A PLANTATION OF YOUNG WHITE PINE TREES.

Make your idle land pay. Plant forest trees on waste places.

Photo by J. S. Illick.

AN ATTRACTIVE AND THRIFTY STAND OF WHITE PINE PLANTED 48 YEARS AGO.

Note the branch scars that encircle the trunks. The distance between the rings is the height growth of one year.

poor quality, and undesirable form, as well as all dead, dying and damaged specimens. In almost every forest there are wolf trees, that is, trees which are unattractive, have a wide-spreading crown, and a twisted and hollow trunk. Such trees grow very little in size and are continuously decreasing in value. They should be removed from the forest for they possess no future promise, and are suppressing and even killing many young and thrifty trees beneath them. Their days of usefulness and service are past, and the way should be opened up for a younger generation of trees by removing their suppressors.

Boys and girls should make it a rule to use for camping and other essential purposes only such material whose removal will improve the forests, and thus assist in rebuilding them and making them even more productive and more valuable than the original forests.

4. Another important thing to do is to stock completely all forest land so that it will begin producing forest products of value. Our forests are now full of gaps and openings in which nothing of value is now being produced. Many of these areas are small in size, while some of them cover large areas. The loss from a single blank area may not be great, but when all of them are added together the loss is enormous.

Let us give nature a chance to establish forests of baby trees on all these areas, but if she does not succeed, the thing to do is to go out upon these barren areas and plant upon them selected trees, which are well-known, sure to grow, and will produce a valuable crop of timber. We must not compete with nature or try to outdo her in places where she is doing good work, but our aim should be to fill in all fail places. Boys and girls can be of great service in this work for there is a big tree planting job before all of us. It will be a creditable piece of work for the young and brave men of our State to go out among the hills and start to re-clothe them with the best trees which are now available.

WHY PLANT FOREST TREES.

Nature working through many centuries produced the original forest. It took a long time for her to accomplish this wonderful task. In some localities nature will again produce fine forests, while in other places she is making progress very slowly. We cannot afford to wait. We must put our idle mountain land to work at once for we need all the forest products which all the available areas are capable of producing.

Wherever nature is not restoring a forest growth, we may go in and help her by planting seedlings of valuable forest trees. The boys and girls of Pennsylvania have already planted many trees, and it is fair to assume that as they learn more about this delightful

pastime and helpful practice they will plant an increasing number each year. You may not know about it, but it is a fact that almost 50 million small forest trees have been raised already in the nurseries operated by the Pennsylvania Department of Forestry and all of them have been planted on forest land within the Keystone State. More than 34 million of these trees have been planted on the State forests, the remainder having been set out by private owners of woodland. How rapidly the practice of forest tree planting is growing may be learned from the following table:

YEAR	Number of Trees Supplied to Private Planters
1910	66,374
1911	25,360
1912	66,854
1913	47,770
1914	108,685
1915	115,577
1916	1,471,875
1917	1,812,997
1918	2,186,899
1919	3,139,531
1920	2,543,374
1921	3,041,710
Total	14,627,006

Every Pennsylvania boy and girl should be a tree planter. It is a helpful and wholesome kind of work. In order that every boy and girl may know some of the good points of tree planting, a list of the benefits that may be derived therefrom follows:

1. Planted trees will help supply the constantly growing demand for wood. They are a credit to us who set them out, and will be a blessing to future generations. Cheap wood is gone forever in Pennsylvania.
2. Planted trees afford excellent protection to our water supplies and prevent erosion on steep slopes.
3. Planted trees beautify and protect homes and make our landscape cheerful.
4. Planted trees utilize the energies of nature which might otherwise be wasted.
5. Planted trees beautify and improve highways, waterways, and byways.
6. Tree planting will make worthless land productive and yield useful forest crops.

7. **Tree planting will help fill up the storehouse of needed wealth.**
8. **The planted forests of France helped win the war.**

There is a great need for forest tree planting. It is not hard to find places upon which trees should be planted. Bare hillsides and poorly stocked mountain land is common, idle corners are present everywhere, and eroding slopes and gullies are doing enormous damage in every community.

Boys and girls should remember that they do not stand alone when they desire to plant trees, for the Pennsylvania Department of Forestry will co-operate with them. It will supply the trees for planting if at least 100 are set out. The only cost attached to the trees is the packing and shipping charges, which should not exceed about 75 cents per thousand. A troop of Boy Scouts in April, 1920, planted one thousand trees upon a hillside near Sellersville, Pa., in about two hours. They enjoyed the work so much that they sent in a "hurry up" order for 500 more, which they also planted and now they are planning to take good care of them and watch them grow in size, value, and beauty.

He that planteth a tree is a servant of God,
He provideth a kindness for many generations,
And faces that he hath not seen shall bless him.

HENRY VAN DYKE

WHY BECOME ACQUAINTED WITH TREES.

Every boy and girl will sooner or later ask themselves the question, why should I put forth any effort to become acquainted with trees for they are such commonplace things? At first they may not be able to satisfy themselves that the study of trees is important, but as they revolve the question in their minds they will begin to see what a wide and practical application to every day life this subject has, and that trees ever since the creation have been among man's best friends and most useful helpers, and as time goes on and wood becomes scarcer they will play an even more important role in satisfying his needs.

Suppose we pause just long enough to think about a few of the ways in which trees have been our friends and helpers. We cannot begin to take an itemized census of all the different benefits derived from them for we would soon have a list as long as our arms and only half finished, but in order that we may not overlook entirely some of their good points a list of the most important of them follows:

1. **Trees decorate the landscape. A treeless place is indeed cheerless.**
2. **Trees supply us with shade and shelter, and protect our houses and other buildings against storms.**

3. **Trees beautify our homes, highways, and byways.**
4. **Trees give shelter to and serve as a refuge for birds and other wild animals.**
5. **Trees supply shade and shelter to domestic animals when in the open.**
6. **Trees help make, fix, and improve the soil.**
7. **Trees protect steep mountain slopes against erosion, and bind the soil along the banks of streams.**
8. **Trees increase the run-off of water during periods of drought.**
9. **Trees help purify the atmosphere.**
10. **Trees decrease the run-off of water during periods of flood.**
11. **Trees help maintain and improve the health and efficiency of our citizens.**
12. **Trees help raise the moral standard and social worth of our boys and girls.**
13. **Trees furnish the raw material for many of our most important industries.**
14. **Trees supply us with some of our most necessary products of life. They supply us with the wood with which to build, furnish and warm our homes. They are the main source of the raw material from which the paper upon which we write is made.**
15. **Every Pennsylvania boy and girl should become acquainted with our native trees so that they can recognize the difference between the important timber trees and the inferior (weed) species.**

HOW TO BECOME ACQUAINTED WITH TREES.

There is more than one way for boys and girls to become acquainted with our common trees. Some are so fortunate as to have a teacher available who knows the trees and is willing to point out their distinctive features and peculiar habits. Others are less fortunate in that they do not have a teacher familiar with the trees, but they do have available for use a good supply of helpful tree leaflets and manuals. But there is a third group of boys and girls and this includes by far the largest number, who have neither a good teacher nor satisfactory literature available to pursue a course of tree study. It is primarily for this third class of boys and girls that the material on the following pages has been prepared.

One of the first things which boys and girls should know about tree study is the fact that to attempt to learn to know all the trees is a big and long job, for there are over a hundred different trees native to Pennsylvania. It may be well in this connection to remember the old adage "Do not attempt too much for fear of accomplishing too little." Much better results will be attained by selecting a small group of trees, or a certain number of representative

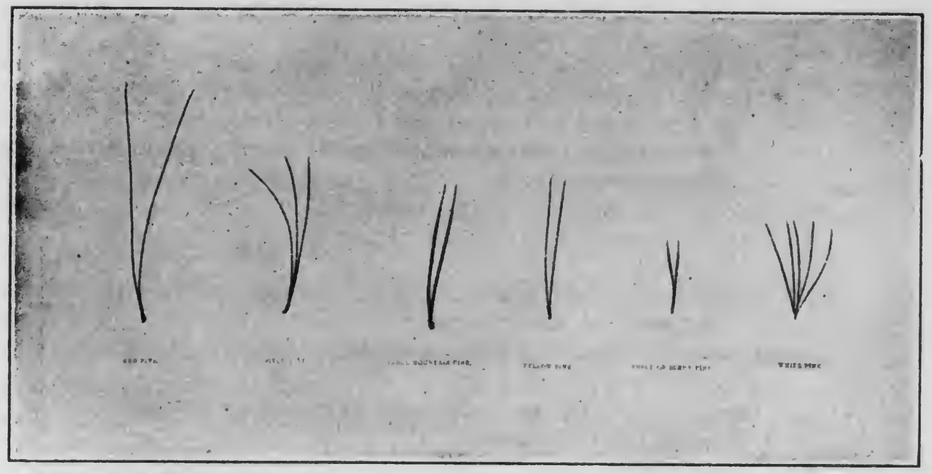


Photo by J. S. Illick.

NEEDLE CLUSTERS OF THE SIX PINES NATIVE TO PENNSYLVANIA

White pine is the only pine native to Pennsylvania with five needles in a cluster; pitch pine has three needles in a cluster; while the other four native pines have two needles in a cluster. Left to right: Red pine, pitch pine, table mountain pine, short-leaf or yellow pine, Jersey or scrub pine, white pine.

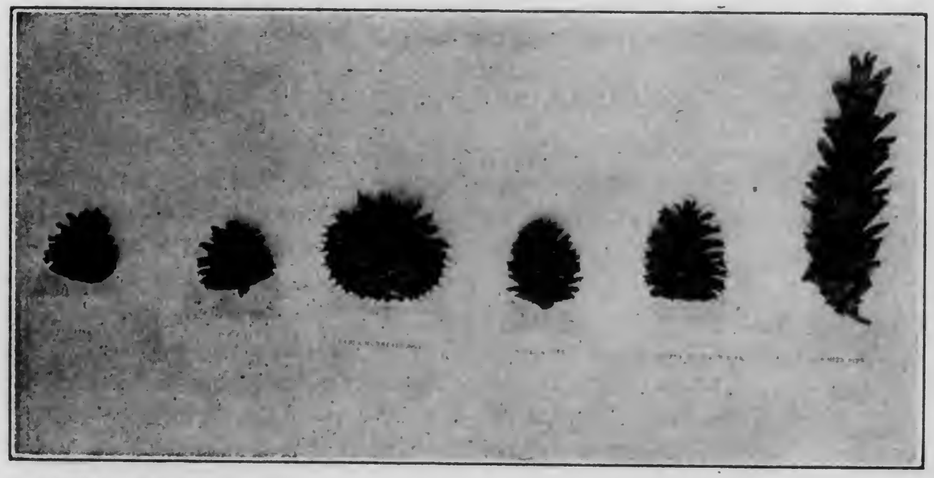
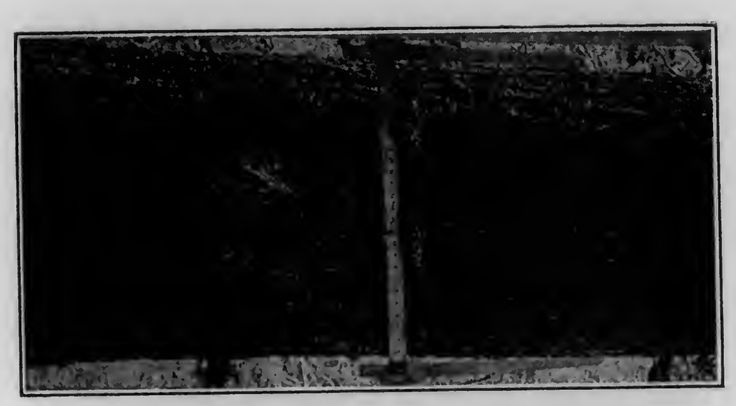


Photo by J. S. Illick.

CONES OF THE SIX PINES NATIVE TO PENNSYLVANIA.

Left to right: Red pine, pitch pine, table mountain pine, short-leaf or yellow pine, Jersey or scrub pine, white pine.

THE PINES OF PENNSYLVANIA MAY BE DISTINGUISHED BY THEIR BARK.



White pine.

Pitch pine.

Short-leaf pine.

Red pine.

species and learn to know them well, rather than attempt to master all of them and later on find that you have acquired only a superficial smattering of most of them and know none real intimately.

SOME REPRESENTATIVE PENNSYLVANIA FOREST TREES.

A small number of Pennsylvania forest trees have been selected for special consideration in this booklet. They are fairly representative trees and possess some striking and interesting characteristics. There are many other equally interesting and important trees which may be considered in later editions. The trees that will be described are:

1. White Pine
2. Red Pine
3. Pitch Pine
4. Short-leaf Pine
5. Jersey or Scrub Pine
6. Table Mountain Pine
7. Buttonwood
8. Sassafras
9. Red Mulberry
10. Sugar Maple
11. Red Maple
12. Silver Maple
13. Ash-leaved Maple
14. Striped Maple
15. Mountain Maple
16. Norway Maple
17. Sycamore Maple.

THE PINES OF PENNSYLVANIA.

Six different kinds of pine trees are native to Pennsylvania. One or more of them occurs in every county of the state, but only the white pine and the pitch pine have a wide distribution. The other four native pines have a rather restricted range.

In the winter months, there is something cheerful and lively in the appearance of the pines in spite of the cold and the snow. They may readily be distinguished by their leaves which are needle-like, occur in clusters of 2, 3, or 5, and persist throughout the winter. The latter characteristic places them among the evergreen trees.

The 34 different pines which are native to North America are classified into two groups, namely, Soft Pines and Hard Pines. Of the pines native to Pennsylvania the white pine alone belongs to the Soft Pine group, the other five species belonging to the Hard Pines.

In order that the pines of Pennsylvania may be recognized by every boy and girl, two simple keys have been prepared, the one based on leaf characteristics and the other on cone features.

LEAF KEY OF PENNSYLVANIA PINES*

1. Leaves slender, 5 in a cluster ..... White Pine
1. Leaves usually stiff, 2 or 3 in a cluster 2
2. Leaves 3 in a cluster ..... Pitch Pine
2. Leaves 2 in a cluster 3
3. Leaves 5 to 6 inches long ..... Red Pine
3. Leaves 4 inches or less in length 4
4. Leaves stiff and very sharp-pointed ..... Table Mountain Pine
4. Leaves slender to slightly stiff, dull-pointed 5
5. Leaves twisted, stout, 1½—3½ inches long ..... Jersey or Scrub Pine
5. Leaves straight, rather slender, about 4 inches long (sometimes 3 or 4 in a cluster, ... Short-leaf Pine

CONE KEY OF PENNSYLVANIA PINES

1. Cones 5 to 10 inches long ..... White Pine
1. Cones less than 4 inches long 2
2. Cone scales not armed with prickles or spines ..... Red Pine
2. Cone scales armed with prickles or spines 3
3. Cone scales armed with prickles 4
3. Cone scales armed with stout spines ..... Table Mountain Pine
4. Cones narrowly and sharply conical when closed ..... Jersey or Scrub Pine
4. Cones broadly and bluntly conical when closed 5
5. Cone scales thickened at apex and armed with short, rigid and recurved prickles ..... Pitch Pine
5. Cone scales slightly enlarged at apex and armed with weak prickles which may fall off early ..... Short-leaf Pine

WHITE PINE

The discovery of the white pine, which is the prince of all the forest trees of eastern North America, coincides with the landing of the Pilgrims on the bleak coast of New England. It was one of the few green things which greeted them, and it truly made a lasting

---

*One of the best methods of identifying trees is by the use of a key. The accompanying keys are simple in their make-up and may be used with little effort. They consist of alternative characteristics of trees made up in pairs and stated in two paragraphs preceded by the same number. Hence, if the characteristics of the tree to be identified do not fit the first paragraph, then they will correspond to those given in the second paragraph, or else the tree in question does not belong to the group considered in the key.

The two companion paragraphs of alternative characteristics are followed either by the name of a tree or by a number. If the name of a tree follows then it is the tree in question; if a number follows then it directs you to two companion paragraphs further on in the key preceded by that number. For example, if you find a pine tree in Pennsylvania with three needles in a cluster you may identify it by the use of the leaf key in the following way: Read the two statements of characteristics preceded by the number "1." The characteristics do not fit the first paragraph but will come under the second paragraph which is followed by "2." This directs you to the two paragraphs preceded by 2; of these the characteristics fit the first and not the second paragraph. Therefore, the tree in question is Pitch Pine, which name follows the first paragraph preceded by the number "2."

OUR NATIVE WHITE PINE MAY BE RECOGNIZED BY ITS DEEPLY-FURROWED BARK.

A CLUSTER OF POLLEN-BEARING BLOSSOMS OF THE WHITE PINE GROUPED BETWEEN THE NEW AND THE OLD NEEDLE CLUSTERS.

Photo by J. S. Illick.

PINE TREES MAY BE RECOGNIZED BY THEIR FORM.

The white pine (left) and the short-leaf pine (right) are of the same age and grew up in the same environment.

and favorable impression upon them and those who came after them. There is no tree in the civilized part of the World which surpasses it in beauty, stateliness, individuality and usefulness.

Many years passed before the entire range of the white pine became known. As the pioneers pushed forward they found that this valuable timber tree had limits. In some localities it was abundant, in other places it was rare, and as they passed beyond the Allegheny Mountains it ceased to be a part of the forest. Now we know that it is found only in the eastern part of North America, extending northward as far as Newfoundland and the northern shore of the Gulf of the St. Lawrence, westward to Manitoba and Minnesota, and southward to northern Illinois and Pennsylvania and along the Alleghenies to Georgia.

In Pennsylvania the white pine originally formed dense stands, especially in the central and northern parts of the State. Many lumbermen claim that the best and most valuable stands of timber found in the whole United States east of Idaho occurred originally in northern Pennsylvania, and consisted of white pine and hemlock. White pine is still common in the mountainous part of the State, occurs sparingly in the western and southeastern parts, and rarely found in the agricultural valleys such as the Lancaster, Lebanon, Chester, Cumberland, Lower Lehigh, and Lower Delaware Valleys.

The white pine is one of our trees which may be recognized without much effort. It is the only evergreen tree native to eastern North America which has its soft, flexible, and bluish-green needles arranged in clusters of five. The lateral branches occur in whorls of 3 to 7 arranged in distinct horizontal layers. After the branches fall off they leave distinct circles of branch-scars along the stems. The cones are 5 to 10 inches long, attached to the twigs by a short stalk, rarely hang long upon the trees, and are covered with thin, flat and unarmed scales.

The wood is soft, straight-grained, and works easily. It weighs about 25 pounds per cubic foot, and was formerly used for a wider range of purposes than any other American wood. It is adapted for practically all purposes except where strength, hardness, flexibility, and durability in contact with the soil are required.

Sawmills began the manufacture of white pine lumber in 1623, and in 1635 a cargo was shipped to England from Massachusetts. Authentic records show that the first house built in America was constructed of white pine. In fact, the wood of this tree held such a prominent place in the lumber industry of America until about 1890 that the history of its exploitation was essentially the history of the whole lumber industry.

The white pine is the most important forest tree in eastern North

America, and probably in the World. It was introduced into England by Lord Weymouth and shortly afterwards into continental Europe, where it has been propagated so extensively that it is no longer regarded as a foreigner but as a naturalized member of their forests.

The white pine promises to become more abundant again, for it is being planted extensively and the remaining natural growth is now given better protection from forest fires and other destructive agents. Since 1902 over 25 million small white pine trees have been planted in Pennsylvania, and during the planting season of 1918 alone over 4 million seedlings and transplants were set out in the Keystone state. They are raised from seed produced in cones on mature trees. At the base of each cone scale two seeds with long brown paper-like wings are produced. The seeds are small in size and brown in color. It takes from 25,000 to 35,000 seeds to make a pound of clean seed. A pound of white pine seed is sufficient to sow a forest tree nursery bed of 100 square feet, and if all goes well, such a bed will produce 10,000 to 15,000 two-year old seedlings.

Many of these baby trees were set out by school boys, school girls and by Boy Scout organizations. Tree planting by boys and girls should be encouraged. It is a pleasant pastime and a useful practice. Their growth will visualize the building-up process in nature and be an excellent counter-part to the tearing-down operations which were impressed so vividly upon all of us during the recent world war.

PITCH PINE

Pitch pine possesses more common names than any other pine native to Pennsylvania. It has at least a dozen of them. Some of them are pitch pine, jack pine, hard pine, yellow pine, torch pine, nigger pine, black pine, scrub pine, long-leaved pine, rich pine, and fat pine. The scientific name of pitch pine is **Pinus rigida.**

Most of the common names refer to some distinctive feature of the tree or its wood. The name black pine and nigger pine refer to the dark bark frequently found upon large trunks. The name torch pine was given to it because it supplied the early settlers with pine knots used as torches about the primitive cabins and for traveling at night. The name yellow pine refers to old and mature trees that have replaced their typical blackish bark with yellowish bark. The names rich pine and fat pine are used locally. The backwoodsmen of Pennsylvania used these names because many of the old trees are rich or fat with resin. The name long-leaved pine is quite appropriate when one considers only the pines of the northeast, for some pitch pine trees develop needles much longer than any of our other native pines. It is not unusual to find trees with needles six or more inches in length.

The pitch pine, next to the white pine, is the easiest of the pines native to Pennsylvania to recognize, for it has positive distinguishing characteristics. Its needles are from three to five inches long and occur in bundles of three. The other hard pines of Pennsylvania have their needles in bundles of two and they vary greatly in length and texture from those of the pitch pine.

The bark of the pitch pine is ragged in appearance and breaks up into irregular plates separated by rather conspicuous furrows. Early in the life of a pitch pine tree the bark becomes quite thick, and after the sapling stage is reached the trees are fire-resistant. This thick bark accounts for the fact that the pitch pine is the most fire-resistant evergreen tree of the East. Forest fires will kill small seedlings, but as soon as the trees reach the sapling stage they develop a heavy bark. Severe forest fires have burned over extensive forest areas, and it appeared as if every living thing had been killed, but upon examining the area a year after the fire, one is often amazed to find that many of the medium-sized and larger pitch pine trees have withstood the extreme heat and are still growing.

Pitch pine does not present a neat appearance; but it is a rather picturesque tree. Its crown is irregular in outline and the trunk is often covered with gnarled branches, and occasionally with dense mats of leaves. It is the only Pennsylvania pine that produces these dense mats of leaves along the main stem, which occasionally envelop the trunk completely.

The cones of pitch pine are from two to two and one-half inches long. They are spherical to ovate in outline when open, persist for many years, and sometimes occur in dense clusters. A few years ago the writer found a cluster of nineteen cones on a small branch upon a young tree in Franklin County, Pennsylvania. Trees loaded down with thousands of cones are common. They may become a burden to the tree, and sometimes prove fatal, for during heavy snow storms the cones make an excellent place upon which the snow accumulates, and it is not unusual for it to collect in such large quantities that the branches break off and sometimes the entire crown is crushed completely.

The pitch pine is found from New Brunswick to Lake Ontario on the north, and south to Virginia, and along the mountains to Georgia, Kentucky, and Tennessee. It is probably the most widely distributed pine in Pennsylvania. It was originally less common than the white pine, but since the great lumbering days, during which the white pine was cut out, the pitch pine has been on the rise. It is found in every county in the State, but is commonest in the mountainous regions where it is associated with the rock oak and chestnut.

There are some excellent stands of pitch pine in Pennsylvania, and it is quite probable that within this State are found some of the best

stands in the entire range of the tree. The pitch pine trees of Mont Alto, in Franklin County, Snow Shoe, in Centre County, and selected stands in Pike and Clearfield Counties are hard to surpass. From a commercial point of view, the pitch pine is not so important a tree as the white pine, but it is gaining favor for new and better uses are continuously being found for its wood. In the early days, when white pine was plentiful, no one cared to handle the inferior pitch pine wood, but conditions have changed and now it is looked upon with favor for many uses. It has won a place in our markets and in time it will move forward to a better position. It seems fair to assume that the wood of this tree will improve in quality when the trees are raised under good forest conditions.

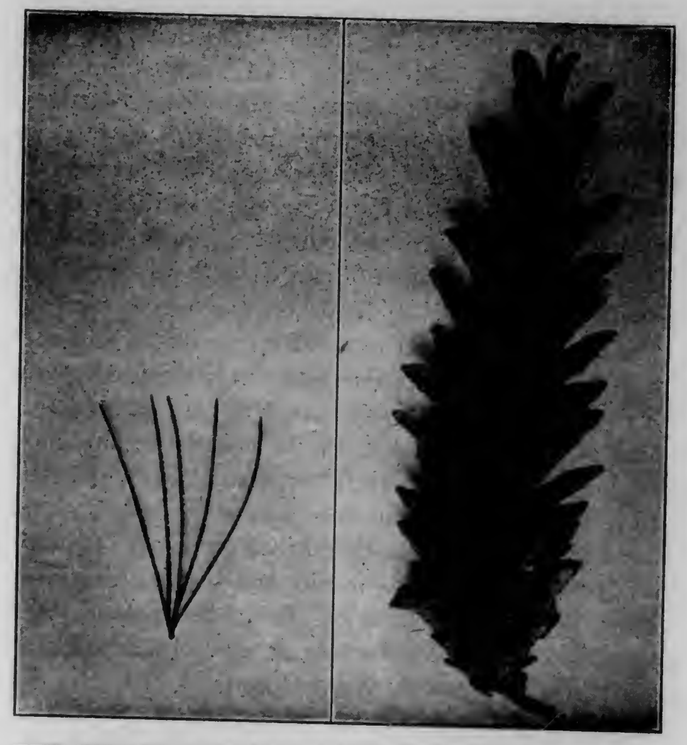
Pitch pine gives us a good example of a tree that should not be condenmed before studying its forest habits and growth peculiarities. Until a few years ago this tree was regarded as a slow grower, and because of this belief was called jack pine. A special study was made of its growth, and it was found that it grew more rapidly than was apparent, for instead of laying on all the growth of the season at one time it often places it in two or more installments. This installment method of growth was responsible for the false notion that it grew slowly.

The wide natural distribution of pitch pine in Pennsylvania,—its fire resistance,—and the fact that it is well adapted to our mountain soil,—recommend it as an important forest tree of Pennsylvania. While it appears to be an ordinary tree, yet it has so many good points that its importance and value will increase as the practice of forestry becomes more firmly established.

RED PINE

The red pine is a valuable timber tree. It has a number of common names. Probably the one used most frequently is Norway pine, a name wholly out of place because it is neither a native of Norway nor does it bear any resemblance to the pine trees of Norway. It is reported that the name Norway pine was given to this tree by a Spanish sea captain who thought this tree resembled pine trees he had seen in Norway. This supposed resemblance is responsible for the inappropriate name of Norway pine which has persisted until to-day and will no doubt continue for a long time, in spite of the fact that it is meaningless and misleading. Another common name is red pine. This is an appropriate name for the bark of the tree is reddish in color and the heartwood is usually pale red. The scientific name of red pine is **Pinus resinosa,** and means resin pine. This name is also inappropriate for its wood contains little resin in comparison with that of other pines.

The red pine is a native of the Northwoods. It extends as far south as central Pennsylvania and the Lake States. It reaches a



THE WHITE PINE HAS A DISTINCTIVE CONE AND ITS NEEDLES OCCUR IN CLUSTERS OF FIVE.

THE OLDEST WHITE PINE PLANTATION ON THE STATE FORESTS OF PENNSYLVANIA. THE TREES HAVE BEEN NUMBERED AND A RECORD OF THE GROWTH OF EACH TREE IS KEPT.

RED PINE HAS A DISTINCTIVE FORM. THE NEEDLES ARE CLUSTERED OR TUFTED AT THE ENDS OF THE BRANCHES.

PROBABLY THE LARGEST SPECIMEN OF TABLE MOUNTAIN PINE IN THE WORLD. IT IS 73 FEET HIGH, 23 INCHES IN DIAMETER AT BREAST-HIGH, AND FROM BRANCHES FOR A DISTANCE OF 40 FEET FROM THE GROUND. IT GREW AMONG HARDWOOD TREES ON A HILLSIDE NEAR MONT ALTO, FRANKLIN COUNTY, PA.

height of 70 or 80 feet and a diameter of 3 feet. In some parts of its natural range it attains an even greater size, and, as a rule, it is mixed with other trees. The optimum growth of this tree is in the northern part of the Lake States and in the southern province of Canada. Recently a new outpost of red pine was found on a farm woodlot near Selinsgrove, in Snyder County, Pennsylvania. This new station is 75 miles south of the most southern station of red pine that was ever reported.

Probably the most distinctive features of the red pine are its needles and cones. The needles are slender, flexible, from 4 to 6 inches long, and occur in clusters of two. They are surrounded at the base by a thin membranous covering or paper-like wrapper. The needles are grouped together in tufts at the ends of the branches. This characteristic is very helpful in recognizing the tree from a distance. The cones are about 2 inches long. They occur at the end of the season's growth and their scales are not armed with any spines or prickles. It is the only pine native to Pennsylvania whose cone-scales are unarmed. In addition to the leaf and cone characteristics, which should enable anyone to identify it at all seasons of the year, its general form and appearance and its distinctive bark will also help to identify it. It is unquestionably one of the most attractive conifers of the northeast and is being planted extensively for ornamental purposes.

The red pine is one of the most important timber trees of Pennsylvania, and as time goes on its real merits will become better known. It is not so abundant now in Pennsylvania as it was originally, for practically all the big trees have been cut out, and only a limited number of young trees have followed after the old veterans. The hope of having red pine in Pennsylvania in the future lies not in the natural growth that is coming on, but in the trees that are being planted. During the past ten years more than 1,000,000 red pine seedlings and transplants were planted on the State Forests of Pennsylvania and about 700,000 more were supplied by the Department of Forestry to private planters throughout the State. This does not include all the red pine trees planted within the State, for additional trees were purchased from nurseries and planted on private forest land. It seems fair to estimate that at least 2,000,000 red pine trees have already been planted in Pennsylvania and most of them are growing rapidly.

This valuable and promising forest tree should be carefully protected and its range extended by planting seedlings and transplants on the large areas of devastated mountain land in Pennsylvania. It has few enemies, grows rapidly, and if planted and protected will produce large quantities of high grade wood which is now urgently needed by our industries and homes.

SHORT-LEAF PINE

The short-leaf pine has more than a dozen common names. Some of them are appropriate, while others are misleading, and may embarrass one who attempts to identify it. The scientific name of the short-leaf pine is **Pinus echinata.** Of its fifteen common names none will ever replace short-leaf pine, for the leaves of this tree are truly short in comparison with those of the longleaf pine and other pines with which it is associated. Its distinctive leaves are from two to four inches long and usually occur in pairs, but occasionally three appear in a cluster, and sometimes four may be found in a group.

The cones of the short-leaf pine are rather distinctive. They are brown in color, from one and one-half to two and one-half inches long, nearly as wide as long when open, and attached to the branches by a short stalk. Each cone-scale has an enlarged end, which is armed with a weak prickle. Early in autumn the cones open to discharge the small triangular seeds which are produced in large numbers and scattered widely about the trees. Heavy seed crops occur at rather short intervals, which justifies one in being hopeful that nature will continue to propagate this important forest tree. Even as far north as southern Pennsylvania a large number of seedling trees are found in openings about older trees.

One of the best distinguishing characteristics of the short-leaf pine is its clean, stately, and slightly tapering, trunk—the bark of which is marked off by deep furrows into irregular or rectangular plates covered with thin scales. Some of the old specimens have been appropriately called "armored knights of the forest," for the bark is so distinctive and the tree trunk so impressive that the tree cannot be confused with its associates.

Short-leaf pine is found over an area of more than 440,000 square miles, but is of commercial importance over about two-thirds of its natural range. Its natural range extends as far north as western Connecticut, but near Mont Alto, in Franklin County, Pennsylvania, is the most northern heavy stand of short-leaf pine in America. In this stand are many stately trees with trunks two and one-half feet in diameter at breast high, and clear of branches for sixty feet from the ground. These magnificient trees are covered with a distinctive armored bark fully as typical as any grown in the south.

The short-leaf pine is commonest in the South, where it makes its best growth at elevations of 400 to 1,500 feet above sea level. It is, however, found from sea level to an altitude of 3,000 feet in the southern Appalachians. The commercial range of short-leaf pine has contracted considerably since the settlement of our country. It once grew as far north as Albany, and from fifty to one hundred years ago it was lumbered in many places in Pennsylvania where it has

now ceased to exist or only a few scattered trees remain. The geographical range is now given as from New York to Florida, west to Missouri, Oklahoma, and northeastern Texas.

In Pennsylvania the short-leaf pine occurs only locally. There is only one heavy stand in the State and that is found near Mont Alto in Franklin County. A few trees are found locally throughout the southeastern part of the State, and scattered specimens have been found as far north as Lycoming County, where it is reported that the tree was formerly far more abundant than it is now. It may be said that the tree is practically extinct in Pennsylvania excepting in local places in the southern and southeastern part of the State. The hope of keeping this important timber tree as a member of the forests of Pennsylvania is in the fact that a considerable number of young trees are beginning to appear about the few old trees that still remain, and a considerable number are being planted for reforestation. In the fall of 1921, 140 pounds of seed were planted in the Mont Alto nursery operated by the Pennsylvania Department of Forestry. With 50,000 to 60,000 seeds to each pound, there should result from this seed sowing at least two million seedlings.

The short-leaf pine is a companionable tree. One may find small forest areas occupied by it exclusively, but in the most of its range it is associated with hardwoods or other evergreen trees. Among its companions are pitch pine, scrub pine, and occasionally loblloly pine. At high elevations the white pine and table mountain pinc stand by its side. Many kinds of hardwoods, such as oak, hickory, sassafras, ash, and cherry, are also associated with it.

The wood of short-leaf pine is hard, strong, and yellowish to dark brown. It weighs about forty pounds to the cubic foot and is used extensively for a large number of purposes. It is in great demand by builders of freight cars, large quantities are used for general construction work, and box and crate makers employ large quantities.

Short-leaf pine has been an important timber tree for many years, and everything points that it will continue to hold a place in the forest structure of southern and southeastern Pennsylvania. It attains a size sufficiently large for forestry purposes, produces excellent wood, yields large quantities of resin, and is well adapted to the climate and soil conditions in the forest regions of southern Pennsylvania and the south Atlantic States.

Every boy and girl interested in outdoor life will do well to try to locate a specimen of short-leaf pine in the natural forests of Pennsylvania and then become its protector. If no specimen can be found in the woods, you can satisfy your desire to perpetuate this

wonderful tree of the southland by planting a number of young seedlings and then watch them grow year by year into stately forest trees.

SCRUB PINE

The scrub pine is unfortunate in its common names. The word "scrub" implies that the tree is undesirable as a forest tree and produces inferior wood. The wood is inferior to that of white pine and some of the other important pines, but this does not necessarily mean that it is not satisfactory for use in wood-using industries. Each year the wood of this tree is being used more extensively for pulp, shipping crates, and general construction work. A few years ago more than 20,000 board feet of lumber were cut from trees of this species in the woodlot of Colonel Henry W. Shoemaker near McElhattan, in Clinton County, Pennsylvania, and used in the construction of one of the most attractive and substantially constructed barns of northern Pennsylvania.

The scrub pine is also called Jersey pine, because it was at one time reported as abundant in parts of New Jersey, where pine forests covered extensive areas known as the "pine barrens." Recent studies, however, show that most of the trees in the pine barrens are pitch pine and not scrub pine. Another common name applied locally to this tree is "slate pine." This name is used widely in southern Pennsylvania where this tree frequently occurs on slaty or shale soil. The scientific name of scrub pine is **Pinus virginiana.**

Scrub pine has many striking distinguishing characteristics. Its needles occur in pairs. They are twisted, spread widely from each other, and are from two to three inches long. These short needles are responsible for the common names "short-leaved pine" and "shortshat pine." No other Pennsylvania pine has needles which are so short, so twisted, and spread so widely. If one takes a position under a scrub pine tree and looks up into its crown, the light seems to be uniformly screened by the evenly distributed short needles. This type of leaf distribution is entirely different from some other pines, particularly the red and pitch pines which have their needles clustered or tufted at the ends of the branches.

The branchlets also have a distinctive feature. They are smooth, purplish, tough, and usually wavy—not stiff and straight as those of the other pines. The bark of the trunk is smoother and redder in color than that of any other native pine. Upon the older trunk the bark peels off in thin scales, giving the trunk a ragged appearance. The cones are narrow and conical, rather sharp-pointed, and often persist for several years. They are helpful in recognizing this small and distinctive forest tree.

The occurrence of the scrub pine may also be helpful in recognizing it. It is neither a tree of the coastal plains nor of the high

mountains, but prefers the rolling uplands between these two extreme positions. It is found from southeastern New York and Pennsylvania south to Georgia and Alabama, and west to Indiana and Kentucky. In Pennsylvania it occurs locally throughout the southern part of the State, and extends as far north as Allegheny County in the western part, Clinton and Lycoming Counties in the central part, and Northampton County in the eastern part.

The scrub pine may be regarded as a pioneer tree, for it is one of the first of our forest trees to march out from the forest and reclaim abandoned fields. There are thousands of acres of farmland in southern and central Pennsylvania abandoned within the last thirty years and now being occupied rapidly by the scrub pine. This tree cannot be placed in the class with the forest giants or sylvan monarchs, but it reaches a height of eighty feet and a diameter of two feet. Usually mature trees are from thirty to forty feet high and have a diameter of eighteen inches. The largest specimen reported in Pennsylvania has a total height of 82 feet and a diameter of 28 inches at breast-high.

TABLE MOUNTAIN PINE

The table mountain pine is the least known of the pines of Pennsylvania. For a long time it was thought that this tree occurred only upon the high tablelands of the southern Allegheny Mountains; but in 1863 a few specimens were found in central Pennsylvania by the late Dr. J. T. Rothrock while tramping over the hills of his native State with his teacher, Dr. Asa Gray—the world-famed botanist of Harvard University. Now this tree is known to occur in many places within the State as far north as Clinton and Union Counties, and northeast to Berks and Schuylkill Counties. These are the most northern outposts that are now known in the tree's entire natural range.

Each year new places are found within the State where the table mountain pine is growing. These new reports may be appearing because the tree is found chiefly in remote and inaccessible situations, which have been little explored by naturalists. The boys and girls of Pennsylvania should get much pleasure by organizinz clubs to go out and find new stations of this rare tree. In order to be successful in this exploration work, it is necessary to go to the rough and rugged mountain tops and ragged cliffs, for it is in such situations that this tree is usually found.

The table mountain pine is also called poverty pine, because it grows and usually thrives on poor, rocky and shallow mountain soils. The scientific name of this pine is **Pinus pungens.** It is an aggressive tree and consequently becomes a good competitor with other trees upon poor soil and exposed situations upon which it sometimes occurs in pure stands. This mountain tree, however,

makes its most rapid growth and develops its best form when standing in mixtures with hardwood trees upon rather fertile soil. What is probably the largest table mountain pine tree ever recorded in the World grew upon a mountain side near Mont Alto, Franklin County, Pennsylvania. This specimen was seventy-three feet high, twenty-three inches in diameter at breast-high, and free from branches for a distance of forty feet from the ground.

While the table mountain pine is typical of our highland forests, it is also found locally at low elevations. A few years ago the writer found a considerable number of trees of this species growing upon an island in the Susquehanna River below McCall's Ferry in Pennsylvania at an elevation of only about two hundred feet above sea level. The roots of the trees are washed continuously by the flowing water—a habitat so different from that upon which they usually occur. Specimens of this tree were also found upon other nearby islands and on the adjoining river hills of York and Lancaster Counties.

Few trees are easier to identify than the table mountain pine. Its needles, which are present at all seasons of the year, occur in pairs. They are very stout, stiff, and extremely sharp-pointed. No other pine tree native to eastern North America has such sharp-pointed needles. The cones of this tree are equally distinctive. They are coarse in appearance and bear cone scales which are armed with stout spines. They are from three to four inches long and usually occur in clusters of three, five, seven, or even more. These distinctive cones often persist for many years and cannot be confused with those of any other cone-bearing tree of the eastern United States.

The preference of this tree for poor rocky soil, and exposed situations, may also help to identify it, for it is found only from Pennsylvania south along the mountains to North Carolina and northern Georgia. When grown in the open its lateral branches persist on the main stem down to the ground, but if grown in dense stands the trunk is free from branches for a considerable distance from the ground, and the wood of such forest-grown specimens is satisfactory for general use.

The table mountain pine cannot be classified as a commercial timber tree of great importance, but it should not be despised, for like all other trees it has some merits. As the practice of forestry becomes more intensive, this tree will be utilized in protection forests on steep mountain slopes where it will help prevent erosion and assist in building up better forest conditions, and while it is doing this it will produce wood that can be used for a large number of ordinary purposes.

BUTTONWOOD OR SYCAMORE

Our native buttonwood tree belongs to the plane tree family. Only three different kinds of buttonwood trees are native to the United States. All of them attain tree size and belong to a group known by the technical name **Platanus**, which means "broad" and refers to the width of the leaves. The leaf-blades are not so broad as those of some tropical trees, but they are among the broadest found in temperate regions.

Probably no person with a practical knowledge of trees ever confuses the buttonwood with any other native forest tree. Notwithstanding the individuality of the tree, it has a good many common names. It is generally known as buttonwood in most of the New England and Middle Atlantic States, but it is also frequently called sycamore. In several of the eastern States, and occasionally in the Mississippi Valley, it is called buttonball, and locally in eastern Pennsylvania and in Delaware the name water beech is given to it. Ever since the closely-related oriental plane tree has been introduced on an extensive scale for ornamental planting, our native buttonwood tree is sometimes spoken of as the plane tree. The scientific name of our native buttonwood is **Platanus occidentalis.**

Our native buttonwood is found from Maine to Ontario and Nebraska, and south to the Gulf States, and west to Texas. It prefers moist, fertile soil but will grow in dry places. In Pennsylvania it is common along the streams and in other wet places in the eastern, southern, central, and western part of the State, but it is rare to absent on dry situations and in the high mountains.

The buttonwood stands out among our forest trees in that it casts its bark as well as its leaves. All trees do this to a greater or less extent, for it is a necessity of life that the bark yield to the pressure of the growing stem from within. Bark shedding is not hidden in the case of the shagbark hickory, silver maple, and ironwood, but the buttonwood is even more open in exhibiting its ability along this line than any other forest tree.

The most striking distinguishing characteristic of our native buttonwood is its thin, smooth, whitish, or pale green bark on young trunks resembling a crazy patchwork of white, green, yellow, and brown. In winter, the predominant color is white, while in summer there is a tendency towards green and brown. The leaves are simple, usually heart-shaped at the base, and wavy on the margin. They are from three to seven-lobed, and hairy or wooly on the lower surface. The most distinctive feature of the leaf is the enlarged or swollen base of the leaf-stalk. In late summer, just before the leaves begin to fall, one of the delights of the country boy is to ask his playmates to find buds on the buttonwood tree. A superficial examination of the twigs causes one to conclude that this tree bears

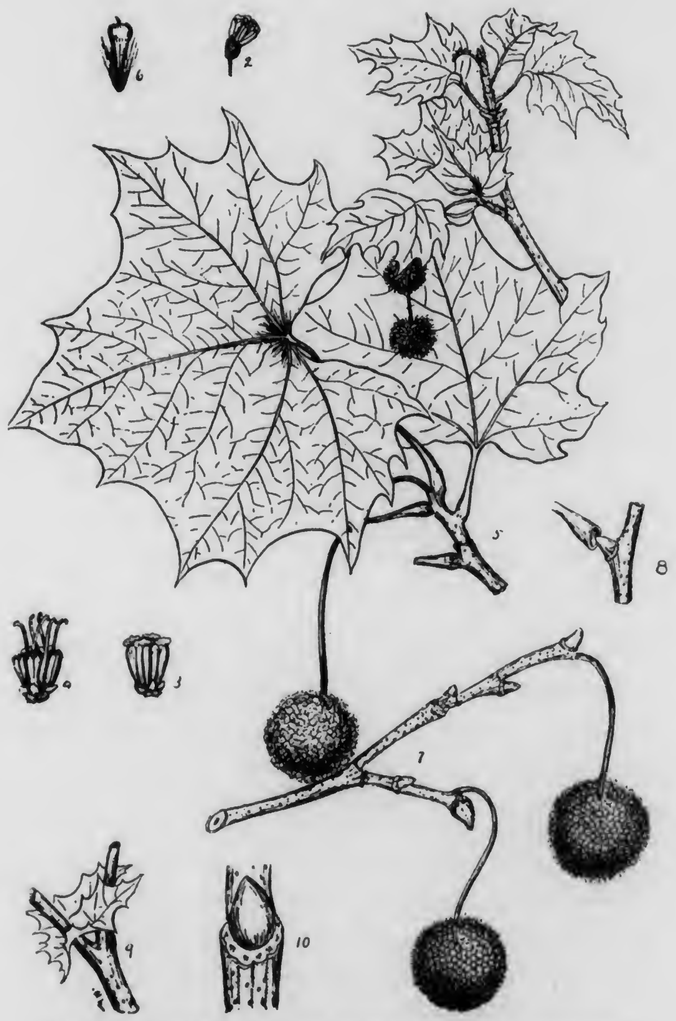
no buds, but a little bit of patience and a somewhat closer examination of the twigs will reveal that the buttonwood does have buds, and that they are hidden entirely under the enlarged stalks of the leaves. Nature seems to have provided a protective cover for the tender buds until they are fit to withstand the cold of late autumn and early winter. As soon as the buds are hardened up, the leaves fall off and the buds are ready for winter exposure. Because of their unusual position, the buds of buttonwood trees are often described as **sub-petiolar**, which means "under the petiole or leaf-stalk." This unusual characteristic enables anyone to identify buttonwood trees very easily during autumn and the winter months.

Another striking characteristic of the buttonwood is its fruit, which consists of small balls suspended on slender stalks. The balls are about one inch in diameter, and composed of a large number of slender and densely-packed seeds. One ball contains thousands of seeds. These balls ripen in late autumn, and may remain attached to the branches far into the winter, and some even hang on the trees until spring.

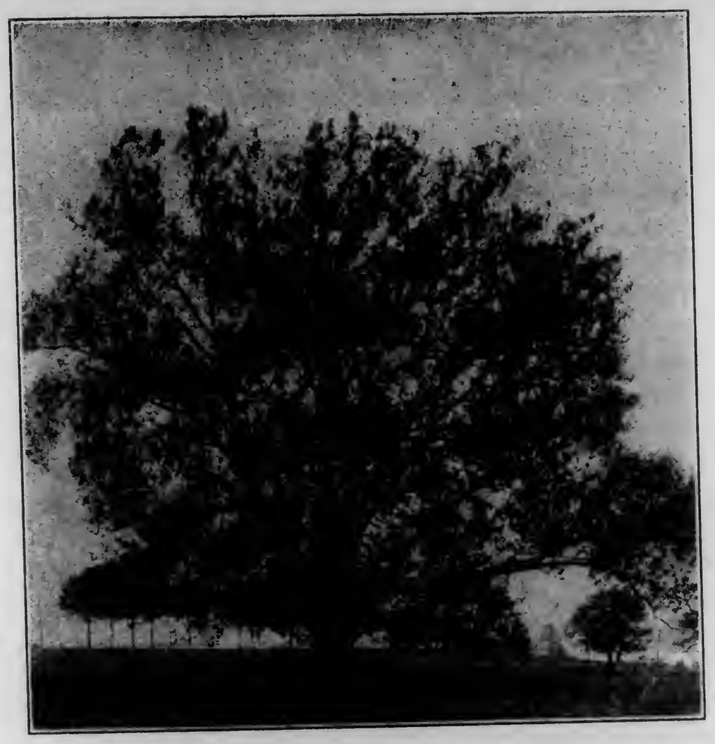
In winter the smooth, reddish-brown, pointed buds are a sure means of identification. They are completely surrounded by a leaf-scar and covered with a single bud-scale. If one takes a good look at the buds and winter twigs of a buttonwood, it will be easy to recognize it at any time during the winter months, for they are such positive distinguishing characteristics that they cannot be confused with those of any other associated forest tree.

The occurrence of the buttonwood is also helpful to identify it, for one usually finds it along the banks of streams, borders of ponds, and other wet places. In winter one often sees long wavy lines of sycamore trees which mark stream courses. They stand out conspicuously among other associated trees because of their white bark and distinctive crown forms.

The wood of the buttonwood is uniformly pale brown, somewhat tinged with red. It is a clean looking wood, and has an attractive appearance when manufactured, which accounts for the fact that it is extensively used in the manufacture of novelties and kitchen utensils. If one examines the numerous household articles offered for sale in a five and ten-cent store, it will be found that many of them are made of the buttonwood. Brush backs, mouse traps, kitchen utensils, and building blocks are among these articles. One of the most desirable characteristics of this wood is the fact that it neither stains or imparts odor or taste to substances that come into contact with it. The latest statistics show that more than 35,000,000 board feet of buttonwood are cut annually. About one-half of this amount is used in the manufacture of boxes and crates. It has

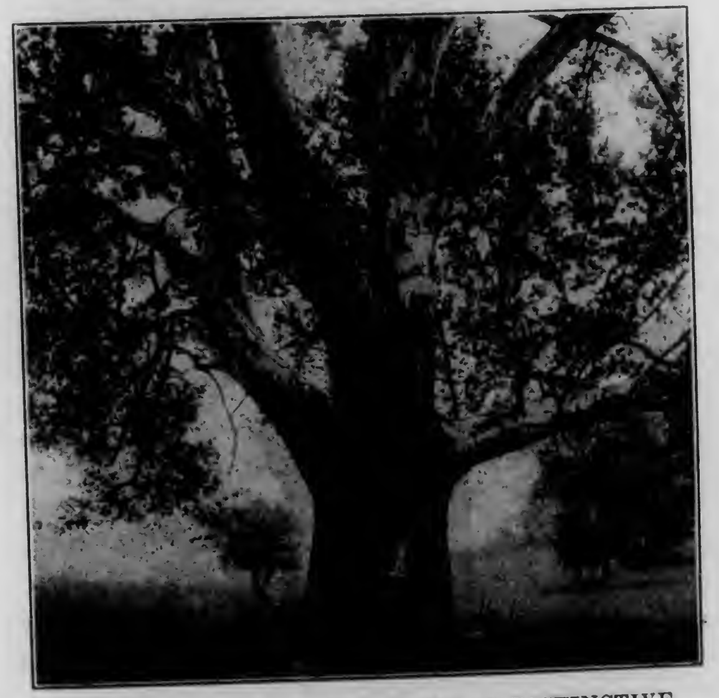


THE BUTTONWOOD OR SYCAMORE IS READILY RECOGNIZED BY ITS DISTINCTIVE LEAVES, PECULIAR BALL-LIKE FRUIT, UNIQUE BUDS AND UNUSUAL LEAF APPENDAGES.



THE GIANT DAUPHIN SYCAMORE.

It is over 25 feet in circumference at the base and stands as a memorial to John Goodway, the last of the friendly Indians of Central Pensylvania.



THE BARK OF THE SYCAMORE IS DISTINCTIVE.

It is a patch work of white, green, brown, and yellow.

long been the favorite wood for boxes for plug tobacco, which stains easily and acquires an unpleasant taste and odor from most other woods.

Our native buttonwood has many good points, but unfortunately it has a number of serious enemies. Among them is a blight which attacks the leaves shortly after they have started to develop in spring. When the leaves are about one-third grown, little brown to black dots begin to appear upon them. These dots enlarge rapidly, and sometimes within a few days the leaves are completely browned up and shriveled, and fall to the ground. The leaves appear to be injured by frost, but the real cause of the damage is the blight, for which no practical remedy has yet been found.

The buttonwood grows at its best throughout the Mississippi Valley, and it also reaches a large size along the main rivers and in the fertile valleys of Pennsylvania. There is a buttonwood tree standing near Linglestown, Dauphin County, Pennsylvania, known as the "Dauphin Sycamore." It has a circumference of more than twenty-five feet at the base, a branch spread of over one hundred feet, and is in a healthy condition. Local historians tell us that the tree stands as a memorial to John Goodway, the last of the friendly Indians that lived in central Pennsylvania. It is said that he is buried about one hundred yards north of this magnificient tree, which remains as a memorial to his otherwise unmarked grave.

Among the historic trees of Pennsylvania is a buttonwood growing near Chadd's Ford in Delaware County. It stands close by the house used by General Lafayette as his headquarters before the battle of Brandywine, September 11, 1777. This tree is about seven feet in diameter, well proportioned, and remains as a worthy memorial to the great general. Another large buttonwood stands in a field on the old Rothermel farm in Maiden Creek Township, Berks County, Pa. It is the biggest tree in Berks County, Pennsylvania. This tree is over thirty-seven feet in circumference near the ground, one hundred and three feet high, and has a spread of branches of over one hundred feet.

The buttonwood is the giant of all American hardwoods. A few years ago a large specimen was found near Worthington, Indiana. It measured forty-two feet and three inches in circumference at five feet above the ground, and is one hundred feet tall. It is not unlike other large sycamore trees in that it branches near the ground. Its east branch is twenty-seven feet and three inches in circumference, and its west branch twenty-three feet and two inches in circumference.

We are just beginning to know the real merits of our native buttonwood. It seems fair to predict that before long its wood will play a more important role in the lumber industry of America than

it has in the past, and with a better understanding of its quality and fuller information about its growth peculiarities, this tree will begin to take a worthy place among our forest trees.

In addition to our native buttonwood or sycamore, another member of the family—native to southern Europe and western Asia—has been introduced extensively into Pennsylvania. It usually goes by the name "oriental plane tree." It has many good points and is being planted rather extensively for ornamental purposes. In the city of Philadelphia there are many specimens of it and most of them appear to be growing well. It grows rapidly, is hardy, possesses a beautiful crown, gives ample shade, has an attractive bark, and is troubled by only a few insects and fungi. It stands in the front rank among our shade trees, and in spite of its foreign origin has established itself firmly among our ornamental trees.

SASSAFRAS

Sassafras is the only tree of its kind in the United States. There is only one other kind of sassafras tree in the World. It is a native of China, and like our native sassafras belongs to the Laurel family. Our native sassafas is found from Massachusetts to Iowa and Kansas, and south to Florida and Texas. In Pennsylvania one rarely finds it in the high mountains, but it is a common lowland tree in the eastern, southern, and western parts of the State. One frequently finds it along fence rows and in abandoned fields where it sometimes forms extensive and dense thickets.

The sassafras was one of the first American trees that became widely known in Europe. The Indians told the early settlers about its medicinal bark and other properties, and the white man immediately attempted to commercialize its bark and other products. It is reported that sassafras roots comprised a part of the first cargo ever exported from Massachusetts. At present its medicinal properties are not prized so highly as in the early days, but its roots are still used in the preparation of "Sassafras tea" and in the manufacture of flavors for medicines and candy. It is a common practice among the mountaineers of southern Pennsylvania to grub out the roots, put them up in small bundles, and carry them to nearby market places where they are sold for a nickel or dime a bundle. Sassafras root collectors prefer to dig them up in abandoned fields and along fence rows where young trees come up in large numbers, often forming dense thickets.

The early inhabitants of Pennsylvania believed that the sassafras possessed miraculous healing properties. People then thought that sassafras could renew the youth of the human race. Even to-day this superstition still clings to this tree, and it is not entirely confined to ignorant people. Bedsteads made of sassafras are supposed to drive away nightly visitors that disturb peaceful slumbers. The

negroes of the South prefer to floor their cabins with sassafras, for they believe that it will keep away animals that may molest them. They believe too that sassafras poles are superior to all other woods for chicken roosts. They are confident that the poles will stop all kinds of men and animals that may attempt to lift the chickens from their roosts.

The distinctive aromatic taste of the bark, roots, and wood, and the accompanying pleasant odor of the sassafras, are the best and most reliable means of identification. If one breaks off a brittle twig of green-barked sassafras, a pleasant aromatic odor is given out immediately, and upon chewing it the flavor of the mucilaginous inner bark is found to be very delicious.

Three distinctive forms of leaves are often present on the same branch. Sometimes an even larger number of leaf forms may be found. The leaves are all simple in form and alternate in their arrangement. The oval entire-margined form is commonest. In the mitten form the leaf has one thumb-like projection which may be either on the right or on the left side. Sometimes the leaves are prominently three-lobed, and occasionally five-lobed specimens may be found.

The fruit is a dark berry which is borne on bright red and club-like fleshy stems and arranged in rather open clusters. It furnishes excellent food for birds but unfortunately does not persist until winter when the birds are often in great need of something to eat.

Sassafras is not an important forest tree in Pennsylvania. It does not occur in every part of the State, for one rarely sees sassafras trees in the cold and mountainous parts of northern Pennsylvania. Near the northern limit of its range it is generally small, but farther south it becomes a large tree frequently 40 to 50 feet high and 1 to 3 feet in diameter. Occasionally a tree is found that is 100 feet high and 3 to 4 feet in diameter.

The largest sassafras tree that has ever been found in Pennsylvania stood in a cemetery at Horsham in Montgomery County. A group of four large sassafras trees are growing along a state road about one-quarter of a mile north of Wawa Station in Delaware County. One of them stands outside of the roadside fence and the other three within the fence. These four trees measure 10 feet 8 inches, 11 feet 8 inches, 10 feet 7 inches, and 10 feet 4 inches in circumference at three feet above the ground. Another large and historic sassafras tree stands near Second and Emerald Streets in Harrisburg. It is a real landmark for the tree is 209 years old. It is 56 feet high and 13 feet in circumference at the base. It was about 15 years old when John Harris—the founder of Harrisburg—was born. This tree is no longer thrifty, for most of its crown has disappeared.

The wood of sassafras resembles that of the Chestnut and it is often substituted for it on the market. In many localities sassafras wood is sought for the purpose of smoking meats, the claim being made that it imparts a very desirable taste. The wood is durable in contact with the soil and consequently used rather extensively for fence posts, rails, and occasionally it is manufactured into furniture. Sassafras wood is used more extensively than our records show for it is usually sold under other names. It is not unusual to find it listed under Ash, and when it is used in the manufacture of coffins it is listed as Chestnut.

There exists no good reason for believing that the sassafras will become extinct, for it produces seeds abundantly and the birds carry them into fence corners and scatter them in large numbers over pastures where the young trees often form dense thickets.

RED MULBERRY

The red mulberry, when first discovered in Virginia, inflamed the early colonists with great hopes, for they thought they had found a new source of food for the silkworm. Unfortunately, their great commercial dreams never came true, for the red mulberry was no satisfactory substitute for the white mulberry, the leaves of which were the chief source of food for the silkworms in Europe and Asia.

The red mulberry is the only mulberry native to the eastern United States. It is found from Massachusetts west to Kansas and south to Texas and Florida. Its best growth occurs in the lower Ohio Valley and the foothills of the southern Appalachian Mountains. Nowhere in Pennsylvania is the native mulberry abundant, but it is found locally in the fertile valleys and along the foothills in the eastern and southern parts of the State. It also occurs locally in the central part, but is generally absent in the cold and mountainous regions.

Being the only representative of its kind, it is not difficult to distinguish the red mulberry from our other forest trees. In summer the large, roundish, sharp-tipped leaves with deeply sunken veins on the upper surface are distinctive. Some of the leaves are lobed and resemble an ordinary mitten in outline. The best distinguishing characteristic of the leaves is the milky secretion given out by the leaf-stalks if pressure is placed upon them. Only a few other trees give milk, and they bear no resemblance to the red mulberry.

The flowers appear in spring when the leaves are about one-fourth developed. There are two kinds, namely, pollen-bearing and seed-producing. Both kinds occur in short tassels (catkins). The pollen-bearing and seed-producing occur separately, but may be found on the same or different trees. The seed-producting blossoms develop

Photo by J. S. Illick.

SASSAFRAS.

Mature and immature (three forms) leaves, flowers, fruit, and a winter twig.

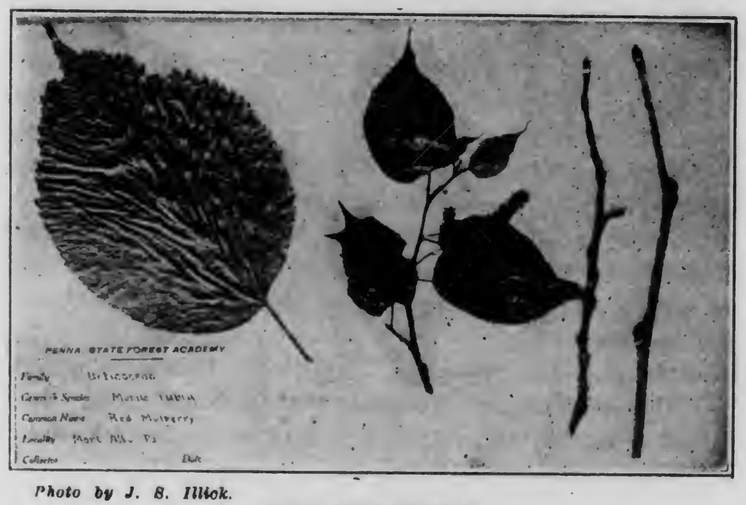
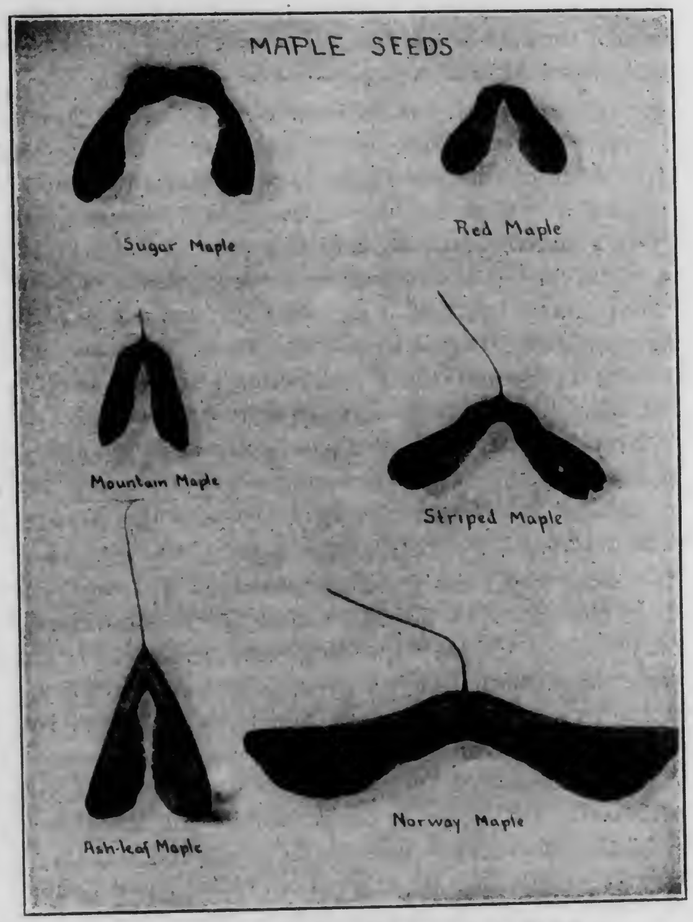


Photo by J. S. Illick.

RED MULBERRY.

Mature and immature leaves, flowers, and winter twigs.



FRUIT OF OUR COMMON MAPLES.

into purplish aggregate fruit which is the distinctive product of the tree. No other native tree produces a fruit which bears any resemblance to that of the mulberries.

In winter the red mulberry is not especially attractive, but it can readily be distinguished if its twigs are examined closely. They are very smooth, clean, and light-greenish brown. A milky juice comes out of them if they are cut. They bear oval and hollow leaf-scars which contain a large number of dot-like bundle-scars arranged in a closed ellipse, or they are sometimes distributed irregularly over the surface of the leaf-scars. No other tree has leaf-scars with such a hollow, bowl-like surface.

Two foreign mulberries have been planted rather extensively in Pennsylvania. They are the white mulberry and the paper mulberry. In some localities they have escaped cultivation and occasionally they are mistaken for the native red mulberry. The white mulberry is a native of China and the paper mulberry is a native of Japan. The former is common in some localities of Pennsylvania and it is not unusual to find it in woodlots and waste places, for in many places it has escaped from cultivation. The paper mulberry is much rarer in Pennsylvania and belongs to an entirely different group of trees. It belongs to a group of trees known by the scientific name **Broussonetia,** while the true mulberries bear the technical name **Morus.** Specimens of paper mulberry may be found upon waste areas near towns and cities, and occasionally it appears as an ornamental tree.

The red mulberry cannot be classified as an important timber tree, but it has many qualities which have been utilized by man. The fruit is valued for fattening hogs and poultry. It is also intimately associated with harvest time, for many a weary harvester has found shelter under its crown, and been refreshed by its fruit. Mulberry trees are common objects along fence rows bordering fields of golden grain. The mulberry waterkeg holds a prominent place in many localities, for it is claimed by the laborers who work in the field that no receptacle is so well adapted to carry and keep water as a keg made of mulberry wood. The wood is very durable and used chiefly by boatbuilders, coopers, and implement makers.

THE MAPLES

The maples are among the best known trees in the Northern Hemisphere. They are abundant in China and Japan, common in Europe, and widely distributed in North America. There are seventy different kinds of maples known in the world. Thirty-five of them are native to China and Japan, and thirteen occur in North America. Six of the latter are native to Pennsylvania.

Japan is the ancestral home of the maples. It is said that one can find in the Island Empire of the Orient traces of the first maple tree that ever grew on the surface of the earth. For centuries the people of Japan have been breeding maples in order to develop varieties with unusual and unique characteristics. The development of pigmy maples is a real art in Japan. For cenuries they have been fashioning these miniature trees, and now there is an established custom in Japan to hold annual Maple Shows, which are in many ways similar to the Rose Shows of America.

While the Japanese maples excel in variety and uniqueness, the American maples are unrivaled in the World in size, beauty, and commercial value. No other group of our native trees show such a wide variation in form and structure as do the maples. They range in size from large commercial timber trees to small trees and shrubs. The leaves of many of them are simple but a few have compound leaves. The twigs of some are slender, while those of others are stout; their color may be green, gray, brown, or red. Maple flowers may occur in small lateral clusters, in long drooping tassels, or in erect spikes. On some maples the flowers appear before the leaves, while on others they appear with or after the leaves. The fruit of the maple is very distinctive. It consists of a pair of winged seeds which is called a maple-key. Each kind of maple tree bears its own distinctive key-like fruit, which can readily be distinguished from that of all other maples.

The maples occur on a wide range of habitats. The ash-leaved maple grows at its best along the streams and along the border of ponds and lakes. The sugar maple prefers well drained, rich soil. The striped maple is satisfied in shaded and moist places, while the mountain maple thrives on dry, rocky hillsides and mountain tops.

Of the thirteen maples native to the United States, nine occur east of the Rocky Mountains, and six of these are native to Pennsylvania. The six maples native to Pennsylvania are:

	COMMON NAMES	SCIENTIFIC NAMES
1.	Sugar Maple; Hard Maple.	Acer saccharum.
2.	Silver Maple; Water Maple.	Acer saccharinum.
3.	Red Maple; Soft Maple.	Acer rubrum.
4.	Ash-leaved Maple; Box Elder.	Acer negundo.
5.	Striped Maple; Moosewood.	Acer pennsylvanicum.
6.	Mountain Maple; Spotted Maple.	Acer spicatum.

The maples as a group have so many different characteristics and such striking features that they can be distinguished with little effort from all other groups of trees at every season of the year. They are readily distinguished from other trees, but some of them are so closely related to each other that it is difficult to tell them apart. The following table gives the distinguishing characteristics of the four big maples of Pennsylvania:

HOW TO RECOGNIZE THE FOUR BIG MAPLES OF PENNSYLVANIA.

	SUGAR MAPLE	SILVER MAPLE	RED MAPLE	ASH-LEAVED MAPLE
LEAVES.	Simple usually 5-lobed, coarsely toothed, pale green on lower surface.	Simple, 5-lobed, silvery white on lower surface, leaf-clefts deep and round-based.	Simple, 3 to 5-lobed, whitish on lower surface; leaf-clefts shallow and sharp-pointed at base.	Compound, with 3 to 5 leaflets.
FLOWERS.	Appear with the leaves. Occur in drooping clusters.	Appear before the leaves. Occur in dense clusters along twigs.	Appear before the leaves. Occur in dense clusters along twigs.	Appear with the leaves. Occur in drooping clusters and spikes.
FRUIT.	Matures in autumn. Medium-sized maple key borne on long stalks and clustered.	Matures in early summer. Large maple key with rather divergent wings.	Matures in early summer. Small maple key, arranged in short lateral clusters.	Matures in late summer. Medium sized maple key with converging wings; arranged in long drooping clusters. May remain on trees over winter.
BUDS.	Brown, sharp-pointed, with 8 to 16 exposed scales. Occur solitary along twigs.	Red, blunt-pointed, clustered along twigs.	Red, blunt-pointed, clustered along twigs.	Short-stalked, blunt-pointed, white wooly; clustered along twigs, only a few bud-scales visible.
BARK.	Grayish brown on twigs, gray to black on main stem, not scaly.	Greenish to reddish brown on twigs, dark gray and scaly on main stem.	Reddish with white dots on twigs, grayish and somewhat scaly on main stems.	Smooth and purplish green on twigs, grayish brown and furrowed on main stem.

THE SUGAR MAPLE

The sugar maple is the best known hardwood tree native to eastern North America. It is found from Newfoundland to Manitoba and south to Florida and Texas. It occurs in every state east of the Mississippi, but is not abundant in the South. It reaches its best development from New England across New York and northern Pennsylvania to Michigan. All who have visited the northwoods know the beauty, stateliness, and healthy appearance of this prince among our forest trees.

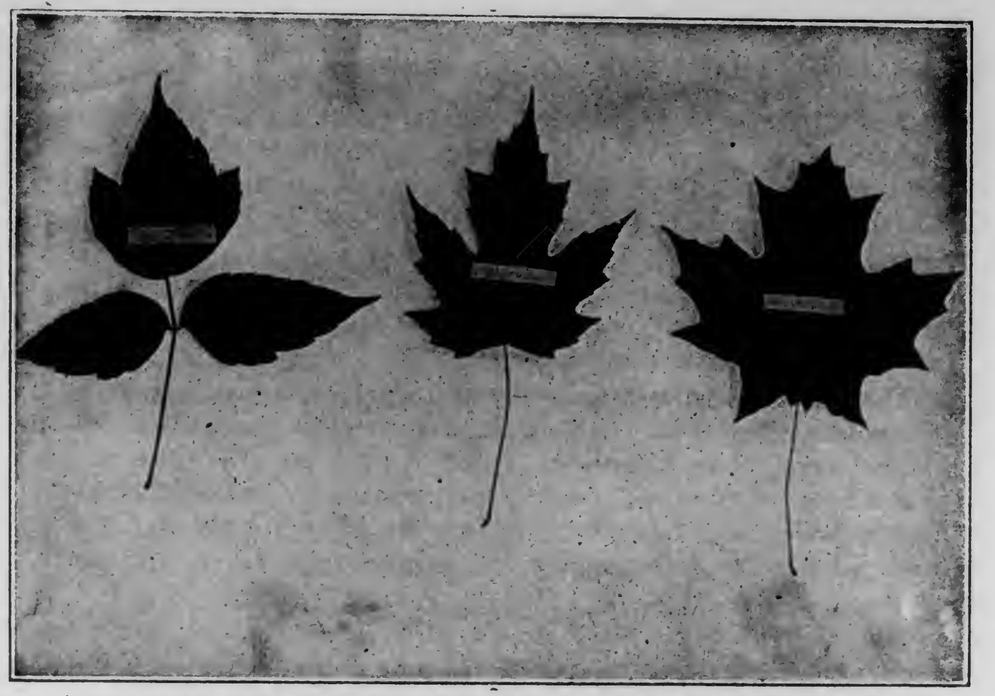
The sugar maple is fortunate in having a number of appropriate common names. The name sugar maple is appropriate for it produces annually large quantities of sweet sap. It is also called hard maple because its wood is hard in comparison with that of the other maples which are often grouped under the name Soft Maple. The name rock maple is also appropriate, because its wood is extremely hard.

The wood of Sugar Maple has a wide range of uses, and the farmer boy regards this tree as a real friend, for when tapped it produces large quantities of sap from which the delicious maple sugar and maple syrup are manufactured. This tree has yielded as high as 550,000 pounds of maple sugar and 275,000 gallons of maple syrup in a single season in Pennsylvania. This shows that the value of the tree lies not only in the fine wood that it produces but also in other products that it yields.

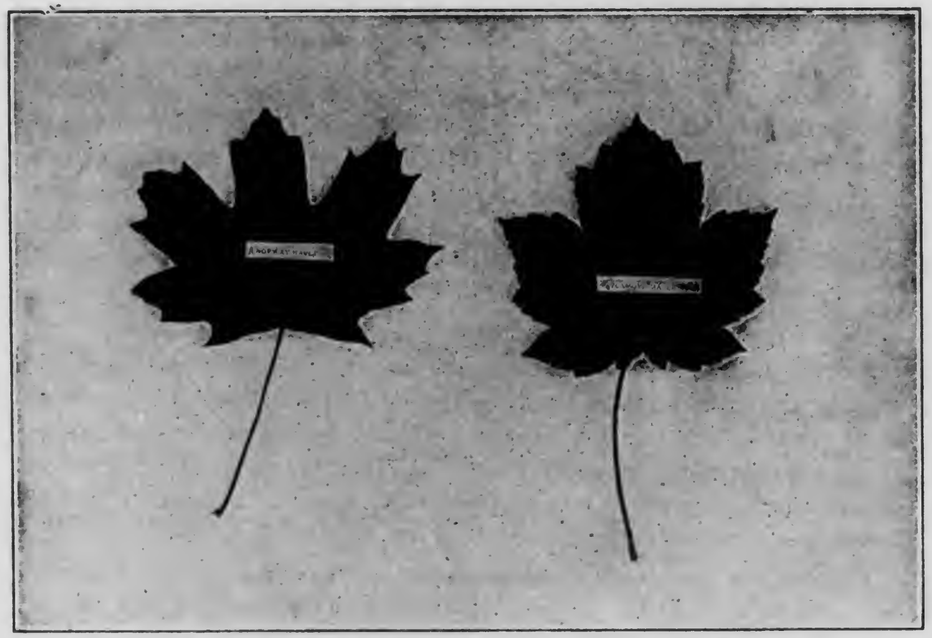
At all seasons of the year the sugar maple may be distinguished with little difficulty. The grayish to black bark on old trunks, roughened by shallow fissures, is always distinctive. The slender, brown twigs, marked with pale dots, are also positive means of identification. In summer its large, simple, and compound leaves, with coarsely-toothed lobes and delicate texture enable one to recognize it.

There is no more positive distinguishing characteristic of the sugar maple than its buds. They are brown in color, sharp-pointed, conical, and covered with 8 to 16 exposed scales. They are clustered at the ends of the twigs, and occur solitary and opposite each other along the side of the twigs. If seen but once, the twigs bearing these distinctive buds cannot be confused with those of any other native forest tree.

The fruit of the sugar maple does not mature until about September. It often persists far into winter, while that of the red maple and silver maple ripens in early summer. The seeds of the sugar maple germinate soon after falling to the ground, and the seedlings form a dense mat on the forest floor. The writer has counted as many as 50,000 small sugar maple seedlings on a single acre of



LEAVES OF THREE COMMON PENNSYLVANIA MAPLES.
Left to right: Ash-leaved maple, silver maple, sugar maple.



LEARN TO KNOW THE INTRODUCED MAPLES.
At the left is the leaf of theNorway maple, and at the right that of the sycamore maple.

A DISTINCTIVE WINTER TWIG OF SUGAR MAPLE.

SUGAR MAPLE. FLOWERS, FRUIT, AND LEAVES.

FLOWERS, LEAVES, AND FRUIT OF SILVER MAPLE.

forest land in northern Pennsylvania, and similar plots are common in New York, Michigan, and Wisconsin.

The wood of the sugar maple is well known and widely used. It touches our hands and satisfies our wants almost daily. We use it more frequently and in a greater number of ways than any other wood. It may be classified as an all-purpose wood, for it is used in the manufacture of at least 500 distinct articles of commerce. It makes the best wooden floor and is one of our chief furniture woods. Large quantities are used in the manufacture of broom handles, refrigerators, kitchen cabinets, toothpicks, children's toys, musical instruments, and agricultural implements. It is difficult to think of any common household article that is not, at one time or another, made from sugar maple wood.

The sugar maple tree is quite common in Pennsylvania. In fact, it is the commonest tree in the State. It is not equally common in all parts of the State, but is more abundant in the northern, northwestern, and northeastern parts of the State than in the southern and southeastern parts. It is a member of the northern hardwood forest, and becomes less common as one enters the southern hardwood forests which extend northward into Pennsylvania along the river valleys.

The sugar maple is one of our most dependable forest trees. It grows rather slowly, but it keeps growing steadily for a long while, and in time it attains a large size. One of the largest sugar maple trees known in Pennsylvania stands near Eagles Mere. It is a forest giant and towers high above all other surrounding trees. It is almost 4 feet in diameter, at breast high, and does not bear a single lateral branch for 60 feet from the ground. An occasional sugar maple reaches a height of 120 feet with a diameter of 5 feet, but specimens of this size are rare.

The sugar maple deserves to be protected and propagated for forestry and ornamental purposes. It produces wood which ranks among the best, yields delicious syrup and sugar, lives long, furnishes excellent shade, and possesses some of the cleanest and most beautiful features of any American forest tree. As a memorial tree the sugar maple has few equals, and as an avenue or roadside tree it ranks among the best.

RED MAPLE

The red maple never forgets its common or scientific name. At all seasons of the year some part of this tree is distinctly red. Early in spring red clusters of flowers appear all along the twigs, and red are the wings of its key-like fruit that matures during May and June. In summer there is a tinge of red on the leaf-stalks and veins of the leaves, and in autumn red maple may be found that stands out

among its neighbors as a flaming torch. The scientific name of the red maple is **Acer rubrum.** This name is appropriate for the word "rubrum" means red. Other common names of this tree are soft maple, which refers to the softness of its wood, and swamp maple, a name given to this tree because it makes its best growth in swampy places.

The range of the red maple covers more than 1,000,000 square miles, and touches every state east of the Mississippi River, and west of it, occurs from South Dakota to Texas. It is found locally throughout Pennsylvania. It is common to abundant in the regions traveresed by rivers and their main tributary streams. It prefers rather wet to swampy ground, but also makes a satisfactory growth on hillsides and often attains large dimensions in fertile farm woodlots in the agricultural valleys of the State. Big red maple trees sometimes exceed 100 feet in height and are more than four feet in diameter. Their average size is about seventy feet in height and two feet in diameter. The largest forest-grown red maple tree recorded in Pennsylvania stands in the woodlot of Jacob Meyers, near Coburn in Centre County. It is almost 4 feet in diameter and free from lateral branches for 50 feet from the ground.

The red maple can be recognized in summer by its simple, rather small, 3 to 5-lobed leaves, which are pale green to whitish on the lower surface, and darker green upon the upper surface. The clefts between the lobes of the leaves are shallow and sharp-pointed at the base. The latter characteristic distinguishes it from the closely-related silver maple which has clefts that are rounded at the base. In winter the red maple is bare of foliage, and displays its distinctive dark-gray bark; also its clean, smooth, grayish branches, and its bright red twigs, loaded rather heavily with clusters of winter buds and dotted with numerous white breathing pores known as lenticels. In winter it is rather difficult to distinguish the red maple from the silver maple. The latter, however, usually lacks the lustrous red twigs of the former and if one breaks the twigs of the silver maple they give off a rather pungent odor not found in the red maple.

The wood of red maple is about three-fourths as strong as that of the sugar maple, and is considerably lighter in weight. In color the wood is light brown, sometimes slightly tinged with red. The sapwood is rather thick, and lighter in color than the heartwood. Lumbermen know the difference between the red maple and our other native maples, but they do not consider it worth while to pile and sell the wood separately. It sometimes comes upon the market as hard maple, and at other times as soft maple, but never is it sold under the name of red maple. The wood is manufactured into flooring, veneer material, and interior finish. Large quantities of it are

A BIG RED MAPLE.

Many big maples are found in Pennsylvania. This one is 4 feet in diameter and clear of branches for 40 feet from the ground.

BARK OF SILVER MAPLE.

Scaly bark and shallow furrows are the main distinguishing characteristics of the silver maple bark.

also being used for pulpwood. It is also sawed into veneer which is made up into berry boxes and peach and potato baskets. Its sap is also collected and manufactured into sugar and syrup, but in smaller quantities than that of the sugar maple. In the days of the pioneer, ink and dyes were made from its bark, which also yielded small quantities of tannin.

There is a place in our forests for the red maple. It is tolerant of shade, grows rather rapidly, and becomes a big forest tree. It deserves a place in the understory of the forest, and, when an opportunity presents itself, it will grow up into the upperstory of the forest and produce valuable lumber.

If there is one maple that excels all other maples in beautiful coloration in the forest it must be the red maple. It also thrives when planted along streets and in parks, but it is rather short-lived and requires plenty of moisture.

SILVER MAPLE

The silver maple is one of the best known of the Pennsylvania maples, for it has a wide natural distribution and has been planted extensively as a shade and ornamental tree. It is a favorite with those who desire to secure shade with as little delay as possible, for it grows rapidly and is adapted to a great variety of soils, but does not flourish upon dry situations. It likes moist to wet places such as are found along river banks and borders of ponds.

The silver maple has a number of common names. Lumbermen usually call it soft maple because the wood is much softer than that of the sugar or hard maple. It is also known as white maple and silver-leaved maple, because the lower leaf surfaces are white or silvery white in color. Other common names are river maple, swamp maple, and water maple. These names refer to the habitat upon which this tree is usually found.

In summer the silver maple may be easily recognized by the silvery white under-surface of the leaves. The bases of the deep leaf-clefts of the silver maple are rounded, while those of the red maple are sharp-angled. The silver maple blossoms very early in spring before the leaves make their appearance. In fact, it is among the earliest of our native trees to bloom. In most localities the flowers appear before those of the red maple. They usually occur in compact, small clusters along the twigs, for each lateral bud usually contains from three to five blossoms ranging in color from reddish to crimson and are favorites with the honey bees which swarm around them on the first warm days of spring. Its fruit matures early in summer and is larger than that of any other of our native eastern maples. The bark is somewhat furrowed and separates into long scales which are often loose at both ends and attached at the middle. This is a helpful distinguishing characteristic at all seasons of the year. The bending down of the branches and the distinctive upward sweep of their small ends is also a helpful means of identification. In winter the silver maple can be distinguished from all other maples, excepting the red maple, by its numerous round, red, clustered buds; and from the red maple it may be distinguished by its bright chestnut-brown twigs which give forth a pungent odor if broken.

The silver maple occurs from New Brunswick and Ontario southward to Florida, and west to Oklahoma and the Dakotas. It is usually found along the banks of streams, borders of swamps, and other wet places. In Pennsylvania it is common along the banks of the principal rivers and their main tributaries. Along these streams it is commonest at the lower altitudes where it, together with the ash-leaved maple and the river birch, sometimes makes up 90 per cent of the trees along the river banks; but as one goes into the mountains and ascends to higher altitudes the tree becomes rarer and about the headwaters of the streams it is often entirely absent.

The silver maple may attain a large size upon favorable situations. It is not unusual to find a tree one hundred feet in height and from three to four feet in diameter. The wood is much softer than that of the sugar maple, but it is used for a wide range of purposes. It is especially prized in the manufacture of fruit baskets and berry boxes.

It is planted extensively for ornamental purposes, for it possesses attractive features. It is one of the first trees to bloom in spring. has an attractive clean bark, and produces beautiful leaves, and if grown in the open its outline and poise suggests an elm. A beautiful cut-leaf variety with a weeping habit has been developed and is being used rather extensively for formal planting. Before planting the silver maple for ornamental purposes, one should know that it is short-lived and its branches are so brittle that they are frequently broken off in winter by the wind and snow and ice pressure.

THE ASH-LEAVED MAPLE

The ash-leaved maple has ten or more common names. Among them are box elder, three-leaved maple, and water ash. There is no good reason why this tree should be called an elder or an ash, except that its leaves are compound. This characteristic is not sufficient reason for calling it a box elder or water ash, for it would be equally correct to call it a hickory or walnut, since these trees also bear compound leaves.

This tree is clearly a maple. Its fruit is a distinct maple-key and cannot be confused with the fruit of any other forest tree. Its compound leaves do not necessarily take it out of the maple group, for

the leaves of some of our native maples are deeply lobed, and it is not a long step to the compound leaf with three leaflets.

The natural range of the ash-leaved maple does not fall far short of 3,000,000 square miles, and is equaled by few other forest trees. It is found from New England across Canada to Alberta, and thence south to Florida, Texas, and Mexico. It thrives in hot and cold climates, and grows well at high and low altitudes and in regions of much and little rain. The fact that it is such an adaptive tree accounts for its wide use in the early days by tree planters in the prairie regions. It was planted more extensively than any other tree by the homesteaders in the Middle West. Its rapid growth afforded early protection against the scorching summer sun and the strong winter winds. It was also among the first street trees in many of the western towns. The people planted it because they knew it would grow, and they were not so sure about some of the other trees. Now better trees have been found and they are willing to replace the ash-leaved maple by more valuable and better species.

The ash-leaved maple is most abundant in the eastern and southern part of Pennsylvania. It is quite common and attains a large size along the streams in the southwestern part of the State, and is the prevailing tree along the Conococheague Creek in Franklin County and other streams and rivers in southern Pennsylvania. As one follows these streams into the mountains, the Ash-leaved Maple becomes rarer and it is usually entirely absent at higher elevations in the northern and central part of Pennsylvania.

The ash-leaved maple differs from all other maples in that it has compound leaves with from three to five leaflets. The other maples of the eastern United States have simple leaves. It also differs from the other maples found within its range by the fact that it usually produces its pollen-bearing and fruit-producing flowers on separate trees, while both pollen-bearing and fruit-producing flowers of the other native maples usually occur on the same tree. This striking difference was formerly regarded sufficient reason to place the tree in a distinct group all by itself, but now it is again classed with the other maples under the technical name **Acer.**

Perhaps the most attractive feature of the ash-leaved maple is the rich color of its twigs. They are gorgeously olive-green and usually covered with a white bloom, and stand out boldly against the skyline. Its stout twigs may, in part, be responsible for the name of water ash. The large, ovate, and downy buds are also distinctive. They occur opposite each other and are usually arranged in small clusters along the twig. The leaf-scars completely encircle the twigs, and their edges meet in such a way as to form a sharp angle. The twigs and the buds are so distinctive that this tree can readily

be recognized during the winter months from all associated forest trees.

The fruit of the ash-leaved maple resembles that of the other maples, but the maple-keys are arranged in drooping clusters and persist far into winter. It is not unusual to find the fruit clusters remaining upon the trees until spring. The seeds are scattered during four or five months of the year, and because of the large number that are produced the future of this tree is quite secure.

The bark on the older tree trunks is rather thick and distinctly furrowed, and it rarely breaks up into scales. The bark bears more resemblance to that of the ashes and basswoods than to other maples. This feature of the tree may be partly responsible for calling it water-ash.

The wood of ash-leaved maple is the lightest of the maples. It weighs less than 27 pounds to the cubic foot, and is manufactured into boxes, crates, flooring, woodenware, and locally into furniture. The tree reaches commercial size in at least thirty states, and in everyone of them it is cut and marketed. Recent tests show that wood pulp manufactured from it is satisfactory, and it is also used by distillation plants with the other maples, beech, and birch, and converted into charcoal and other products of distillation.

The ash-leaved maple deserves a place in our forests, and it may also be planted for ornamental purposes, but great care should be taken in selecting places upon which to plant it. It will grow well if set out in soil adapted to it, but one should remember that it prefers moist to wet soil. It will make its best growth if planted along the borders of streams or about ponds and lakes. If planted upon favorable situations it will grow fast and produce a dense and satisfactory shade. As a shade tree it has the advantages of rapid growth, dense foliage, and pleasing color. It is also comparatively free from the attack of fungi and insects. The chief objection to it as an ornamental tree is its habit of always shedding something. The blossoms litter the ground in spring, the seeds are dropped from early winter until springtime, and the leaves fall in and out of season.

TWO SMALL PENNSYLVANIA MAPLES

The two Tom Thumb maples of Pennsylvania are the mountain maple and the striped maple. Neither of these trees attain a size sufficiently large to classify them as timber trees, but both are so attractive and have such striking distinguishing characteristics that they deserve a place in our forests and in ornamental plantings. To those people who are fortunate enough to spend their summer vacations in the mountainous parts of the Northwoods, the mountain maple and the striped maple are familiar sights. Over large regions these shrubs or small trees are found along highways, by the margin of trout brooks, and about ponds and lakes. Both of them

ERECT FLOWER, SPIKES, AND LEAVES OF THE MOUNTAIN MAPLE.

FLOWERS, LEAVES, FRUIT OF THE STRIPED MAPLE.

are satisfied to take their place in the under-story of the forest, while others of their kin reach up high and struggle for a place in the upper-story of the forest. The following table gives the striking distinguishing characteristics of these two beautiful small maples:

	MOUNTAIN MAPLE.	STRIPED MAPLE.
FORM AND SIZE,	Shrub or small tree, rarely over 15 feet high; often occurs in clumps.	Small tree, usually 15-30 feet high.
LEAVES,	Usually 3-lobed, coarsely toothed, 3-5 inches long. light hairy on lower surface.	Goose-foot-like, 5-6 inches long. 3-lobed at apex, finely toothed, prominently veined; rusty hairs on lower surface.
FLOWERS,	Occur in erect spikes, 3 to 4 inches long.	Occur in drooping tassels 3 to 4 inches long.
FRUIT,	Small maple key about ½ inch long, arranged in dense drooping clusters.	Small maple key about ¾ of an inch long, arranged in open drooping clusters.
BARK,	On twigs reddish brown to gray; on stem reddish brown dotted with gray blotches.	On twigs reddish; on stem reddish brown streaked with long white lines.
HABITAT,	Prefers rocky situations on mountain tops and hillsides.	Prefers moist situations in dense woods.

THE MOUNTAIN MAPLE

The mountain maple has an appropriate common name, for it is a mountain tree. One usually finds it on moist rocky hillsides and along the border of ravines and highways. It seldom reaches a height greater than 20 or 25 feet. In the Northwoods it is usually small, often occurs in clumps, and occasionally it forms dense thickets. In the South it becomes larger and it is not unusual to find specimens that stand alone. In western North Carolina one can find trees with a breast-high diameter up to 12 inches.

The mountain maple is native from Newfoundland to Manitoba, south to Michigan and Pennsylvania, and extends along the Allegheny Mountains to Georgia. In Pennsylvania it is found locally in all parts of the State. It is rare in the eastern and western parts, and common in the mountains of central and northern Pennsylvania. The natives of Potter County call this tree "spotted maple" because of the gray dots that are spotted over the reddish brown bark.

The mountain maple can be distinguished by its simple 3 to 5-lobed and coarsely-toothed leaves. They are smaller, more evidently lobed, less conspicuously veined, and less hairy on the lower leaf surface than those of the striped maple. The new twigs of early summer are greenish and more or less downy, but after the leaves drop in autumn the small twigs have a rather distinct reddish brown to crimson color. If one examines the twigs closely there is seen upon them a whitish coating of fine hairs which enables one to distinguish the mountain maple from all other closely-related trees.

The flowers of the mountain maple do not appear until early summer—a short while after the leaves have reached full size. They are arranged in erect spikes at the end of the new growth. No other native maple has its white flowers arranged in such conspicuous erect spikes. The fruit matures slowly during the summer, ripens in autumn, and often remains upon the trees far into winter. During late summer and early fall the key-fruits often take on wonderful hues of red, and may furnish one of the most attractive features of the landscape. The individual fruit-keys are smaller than those of any other native maple and are clustered on slender drooping stalks.

The mountain maple is of practically no commercial importance as a timber tree, but it is valuable as a soil protector on rocky slopes, and very desirable for ornamental purposes. It seems strange that this tree is not more widely used in landscape gardening, for at all seasons of the year it possesses attractive features. It is very hardy, and apparently free from insect and fungous enemies. This tree has enough good points to justify a more extensive planting for ornamental purposes.

THE STRIPED MAPLE

The striped maple is one of the most distinctive members of the under-story of the forests of the Northwoods. Anyone who has wandered through the mountains of the North or the Alleghenies must have met this beautiful little tree. It is usually found beneath the big monarchs of the forest, and one cannot miss it for it is so beautiful and its white-streaked bark compels attention.

In summer the striped maple is easily recognized by the large goose-foot-like leaves which have a rather thin blade and are fashioned with a delicate network of veins. The upper surface of the leaves is dark green, while the lower surface is considerably lighter in color and clothed with short rusty brown to reddish hairs. The margins of the leaves are finely-toothed, and the leaf-blade is divided into three more or less conspicuous lobes. In spring and early summer, just when the leaves are about fully developed, the drooping clusters of beautiful yellow flowers dangle down from the twigs. The individual flowers are small, bell-shaped, and greenish to yellow in color. They cannot be confused with those of any other maple. The fruit is a typical small maple key with the wings united at a rather wide angle. It matures early in autumn, and there are about 15,000 seeds per pound.

The best way to distinguish the striped maple, also known as moosewood and whistlewood, is by its beautiful striped markings on the bark. The bark is generally some hue of green, or red, and streaked through it are conspicuous white lines. This characteristic is responsible for the name "streaked maple" which is used by the

inhabitants of Potter and adjoining counties in Pennsylvania. In winter the large evidently-stalked buds covered with two smooth bud-scales, the smooth reddish-brown twigs, and the brown pith will enable anyone to distinguish this beautiful and distinctive small forest tree.

The striped maple has practically no commercial value as a forest tree, but its attractive features recommend it highly for ornamental purposes and as a member of the under-story of our natural forests it is worthy of our best care and protection.

TWO FOREIGN MAPLES

Two European maples have been planted widely for shade and ornamental purposes in Pennsylvania. They are the norway maple and the sycamore maple. It is difficult to find a town or city within the State in which one of these trees has not been planted, and in many places fifty or more per cent of all the street trees are Norway and sycamore maple. These two well-known and widely distributed foreign trees have a number of features in common, but they can be distinguished from each other at all seasons of the year by the characteristics set forth in the following table:

	NORWAY MAPLE.	SYCAMORE MAPLE.
BARK,	Black, furrowed, not scaly.	Brown, scaly, not furrowed.
LEAVES,	Flexible, large, coarsely-toothed, almost entire on margin, smooth on lower surface, resembles Sugar Maple; leaf-stalks contain milky sap.	Firm, 3 to 5-lobed, sharply-toothed on margin, slightly hairy on lower surface; leaf-stalks do not contain milky sap.
FLOWERS,	Arranged in yellowish green clusters.	Arranged in erect spikes about 3 inches long.
FRUIT,	Large maple-key with widely divergent wings.	Small maple-key with almost parallel wings.
BUDS,	Large and red.	Large and green.

NORWAY MAPLE

The norway maple comes to us from Europe, where it is found from Norway to Switzerland. In its native home it reaches a height of 100 feet and a diameter of 3 feet. It is occasionally used for forest purposes, but its main value is as a street, shade, and ornamental tree.

The norway maple can readily be distinguished in summer by its large leaves, which resemble those of the sugar maple, but they are deeper green in color and firmer in texture. Its large-toothed and almost entire-margined leaves are readily distinguished from the 3 to 5-lobed and smaller leaves of the sycamore maple. A chacter-

istic by which the norway maple can always be identified is the presence of milky sap in the leaf-stalks, for no other maple of Pennsylvania has this rare characteristic. The milky sap flows freely if the leaf-stalks are twisted or pressed. Another feature by which this tree may be recognized in spring and early summer is its yellowish green flowers. They are produced in large numbers and arranged in dense clusters along the twigs. They come out of the same buds as do the leaves, and blossom when the leaves are from one-third to one-half developed.

In winter this tree can be recognized by its large red, blunt-pointed and glossy buds. They are usually bright red but may be more or less olive green at the base especially in autumn before they are mature. The lateral buds stand close to the twigs while those of the sycamore maple project outward. The fruit of the norway maple does not ripen fully until late in summer or early autumn. They are larger and more beautiful and distinctive in form than those of any of our native maples. These key-fruits have wide divergent wings, which enables one to distinguish this tree from all other maples. Many of the key-fruits remain upon the tree after the leaves have fallen. Sometimes they hang upon the trees all winter, and because of their large size and distinctive form are helpful in recognizing this tree during winter months.

The norway maple is one of the most attractive of our ornamental trees and is unquestionably the best maple that we have for street use. It is especially adapted for city planting because it is tolerant of unfavorable city conditions. It is also hardy, rather free from the attacks of insects and fungi, and retains its leaves longer in fall than our native maples.

SYCAMORE MAPLE

The sycamore maple, like the norway maple, is a European tree. It takes its name from the fact that its leaves are supposed to resemble those of a sycamore. In central Europe it attains a height of 120 feet, and develops a large spreading crown. The trunk is sometimes furrowed, and the bark flakes off in thin scales. In its habit of growth it follows the norway maple, except that its top is not so compact, and it is also less tolerant of soil conditions and consequently is not planted so extensively as its European brother.

The sycamore maple is readily distinguished by its firm 3 to 5-lobed leaves with sharp-toothed margins. The clefts in the leaves are sharp-angled, and the lower leaf-surface is usually somewhat hairy. In winter the large blunt-pointed green buds, the bud-scales of which usually have a black margin, are a sure means of identification. Its leaf-scars do not quite encircle the twigs, while those of

the norway maple reach completely around the twigs. The little dots on the twigs known as lenticels are more numerous on the sycamore maple than on the norway maple. The lateral buds of the sycamore maple stand out from the twigs, while those of the norway maple hug the twigs closely. The fruit-keys of the sycamore maple are smaller and thin wings less divergent than those of the norway maple. These characteristics enable one to distinguish the two widely introduced European maples at all seasons of the year.

The sycamore maple is not so hardy as the norway maple, nor is there anything distinctive about the tree to make it preferable to our native hard maple. It is often attacked by borers and does not thrive on all kinds of soil. There exists no good reason for planting this foreign maple on an extensive scale in Pennsylvania.

WHERE TO STUDY TREES

The place to study our trees is not so important as the time to begin getting acquainted with them. The thing to do is to start studying them to-day, and not wait until to-morrow or next week. If you live in a city and it is not convenient or possible to go out in the woods, you may study the trees along the streets or in the parks. The small woodlots, fence rows, stream banks, and abandoned fields are much better places. But, the best place for a real study of our native trees is the remote wildwoods, that is, the extensive and natural forests on our mountain slopes, hilltops, and valleys.

In the woods of Pennsylvania there are more than 100 different kinds of native trees, and when one observes them in the remote mountain regions they look so natural and fresh. Associated with them are many other plants and a large number of animals. If you are really anxious to learn to know the trees and can possibly do so, take a hike to the wildwoods and there observe the wonders of nature and study the works and ways of the wild folks.

No woods within the State are better equipped for tree study than the State Forests. In 1897, the State of Pennsylvania, through its Department of Forestry, began buying land for forestry purposes. To date (January 1, 1922) 1,126,237 acres have been purchased at an average cost of $2.26 per acre. This large area is now being developed so that it will yield not only wood, but be of the greatest service to the inhabitants and visitors of the State.

In order to handle the state-owned land properly, the aggregate area has been divided into State Forests, each one of which is in charge of a technically trained Forester, who aims to manage the land in his care in the best interests of the public.

An increasing number of people are annually seeking the advantages and benefits of a few weeks of real out-of-door life on the State Forests. The Foresters will help you select a suitable camp

site, tell you about the streams, springs, roads, trails, and look-out towers, and even help teach the boys and girls about the trees, shrubs, herbs, and other plants and animals of the forest.

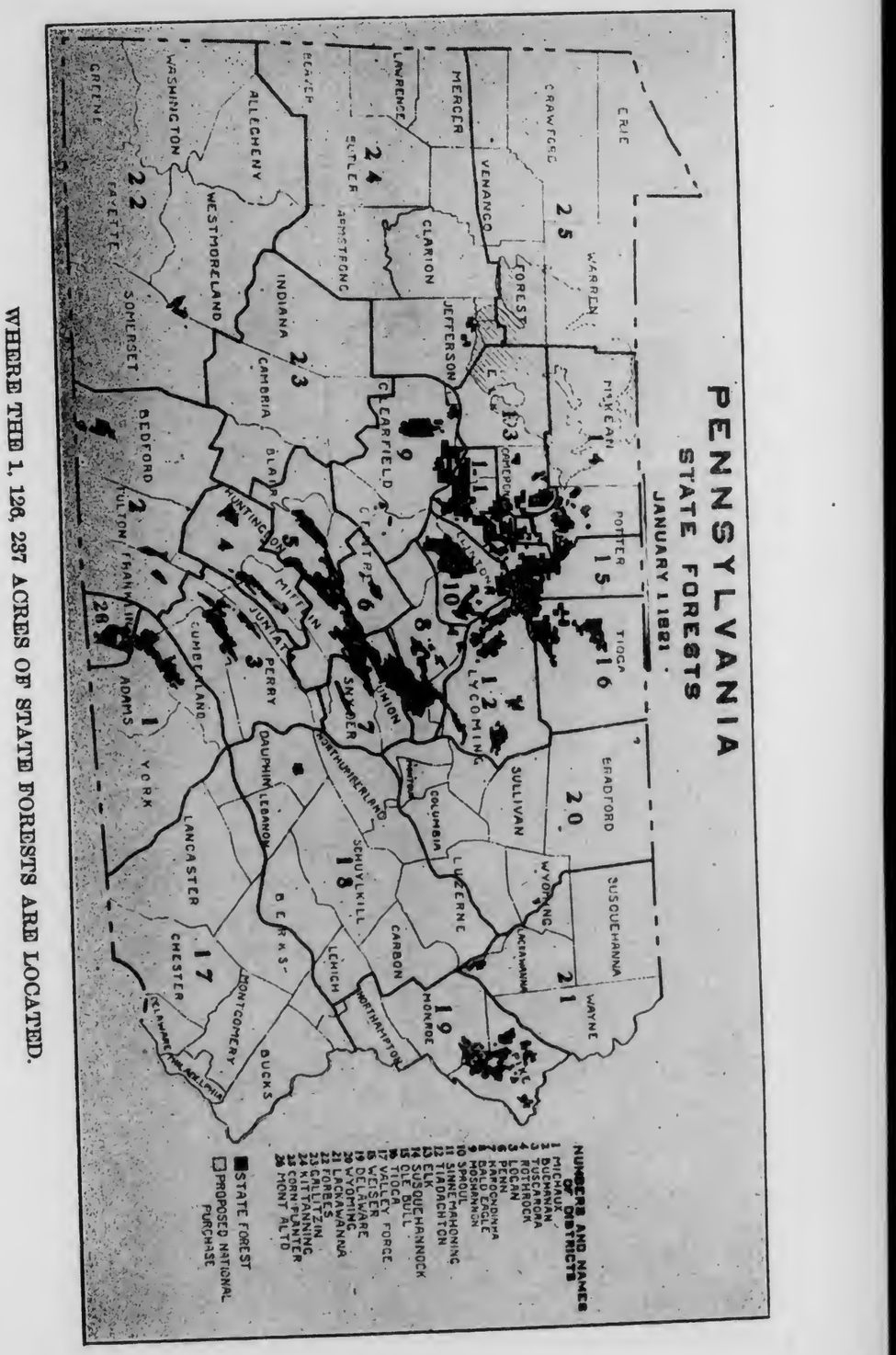
WHERE THE STATE FORESTS ARE LOCATED

Most of the State Forests of Pennsylvania are located in the mountainous part of the State. They are wide open for use and contain some of the best playgrounds and rest places. If you are planning a trip to the mountains, a week in the woods, or some other out-of-door doings, it may save you much money and eliminate a lot of worry if you look over the following table, which tells you where the forest land now (January 1, 1922) owned by the State of Pennsylvania is located:

	COUNTY	ACRES
1.	Adams,	20,887
2.	Bedford,	10,756
3.	Cameron,	83,055
4.	Centre,	79,388
5.	Clearfield,	64,875
6.	Clinton,	143,829
7.	Cumberland,	21,720
8.	Dauphin,	3,808
9.	Elk,	22,767
10.	Franklin,	34,677
11.	Fulton,	6,355
12.	Huntingdon,	62,249
13.	Jefferson,	5,681
14.	Juniata,	3,534
15.	Lackawanna,	5,275
16.	Lycoming,	104,306
17.	Mifflin,	50,383
18.	Monroe,	6,400
19.	Perry,	29,468
20.	Pike,	58,109
21.	Potter,	158,785
22.	Snyder,	19,087
23.	Somerset,	3,467
24.	Tioga,	66,941
25.	Union,	54,193
26.	Westmoreland,	5,065
27.	Wyoming,	1,177
	Total,	1,126,237

YOU ARE WELCOME ON THE STATE FOREST

The people of Pennsylvania own over one million acres of forest land which is being administered for them by the Department of Forestry. Every acre of this vast area, which comprises some of the



WHERE THE 1, 126, 237 ACRES OF STATE FORESTS ARE LOCATED.

most attractive camp site, finest fishing streams, and best hunting ground within the State, is open for public use.

You do not need a pass to go on the State Forests and to enjoy yourself. They are neither surrounded with high stone walls or barbed wire fences, nor with signboards bearing the words "No Trespassing", "Closed", or "No Admittance". Instead each forest is wide open for business and for play.

All that will be required of you is to obey a few simple rules which all good citizens of the State are always willing to do. There is no red tape to this proposition of public use of State Forest land. It is a whole-hearted plan which aims to be of the greatest service and utmost benefit to all the people of the State.

Remember that you are always welcome on the State Forests of Pennsylvania. The Foresters in charge of them will be delighted to show you over the woodland areas in their care. They will do more than merely greet you, for one of their duties is to help you locate a suitable camp site and tell you how to get a camping permit. They will explain to you the rules and regulations of the forest and direct you to fine fishing streams. They will also point out good roads, attractive trails, beautiful vistas, wonderful look-outs, and in addition tell you many interesting things about forestry.

FACTS ABOUT PENNSYLVANIA STATE FORESTS

The original forests covered practically every acre of ground in Pennsylvania. More than thirteen million acres are still classified as forest land, but about five million are barren and unproductive. This is the Pennsylvania Desert.

The Department of Forestry began purchasing forest land in 1898. The total area of forest land owned by the State (January 1, 1922) was 1,126,237 acres. The average price paid per acre was $2.26.

Forestry is a business enterprise. A concise financial statement pertaining to the State Forests follows:

Total purchase price	$2,546,407.71
Total amount expended for administration, development and improvement	5,182,262.68
Total investment and expenditures	7,728,670.39
Amount deposited in State school fund	241,793.64
Net expenditure	7,486,876.75
Estimated present value of forests	$12,255,439.51
Net expenditures	7,486,876.75
Net gain on investment	$4,768,562.76

The Department of Forestry has paid for road, school and county taxes $616,040.17 to the counties in which the State Forests are located.

There are 60 Foresters and 82 Forest Rangers in the employe of the Department of Forestry.

There are 2,628 local and special Forest Fire Wardens in the State who watch for and fight forest fires.

There are 422 State-owned buildings on the State Forests valued at $306,329.39.

Approximately 2,000 miles of forest boundaries have been surveyed, cleared, and marked.

More than 4,000 miles of roads, trails, and fire lines have been constructed and are being maintained.

During 1921, 400 temporary camping permits were issued to 5,000 persons.

More than 750 leases for permanent camp sites have been issued.

Seventy steel fire look-out towers have been erected by the Department of Forestry for the purpose of detecting forest fires, and four steel towers were erected by the Anthracite Forest Protective Association.

Three forest tree nurseries are maintained by the Department of Forestry, which are producing from five to eight million trees each year.

A total of 34,222,596 trees have been planted on State Forests. The plantations now cover 22,468 acres.

During the last twelve years private planters have received from the Department of Forestry 14,627,006 trees, which were set out in all parts of the State.

Within the State Forests are many of the best places to rest, finest fishing streams, best hunting grounds, and grandest views within the State.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTRY

FOREST PROTECTION
FIRE PREVENTION AND EXTINCTION

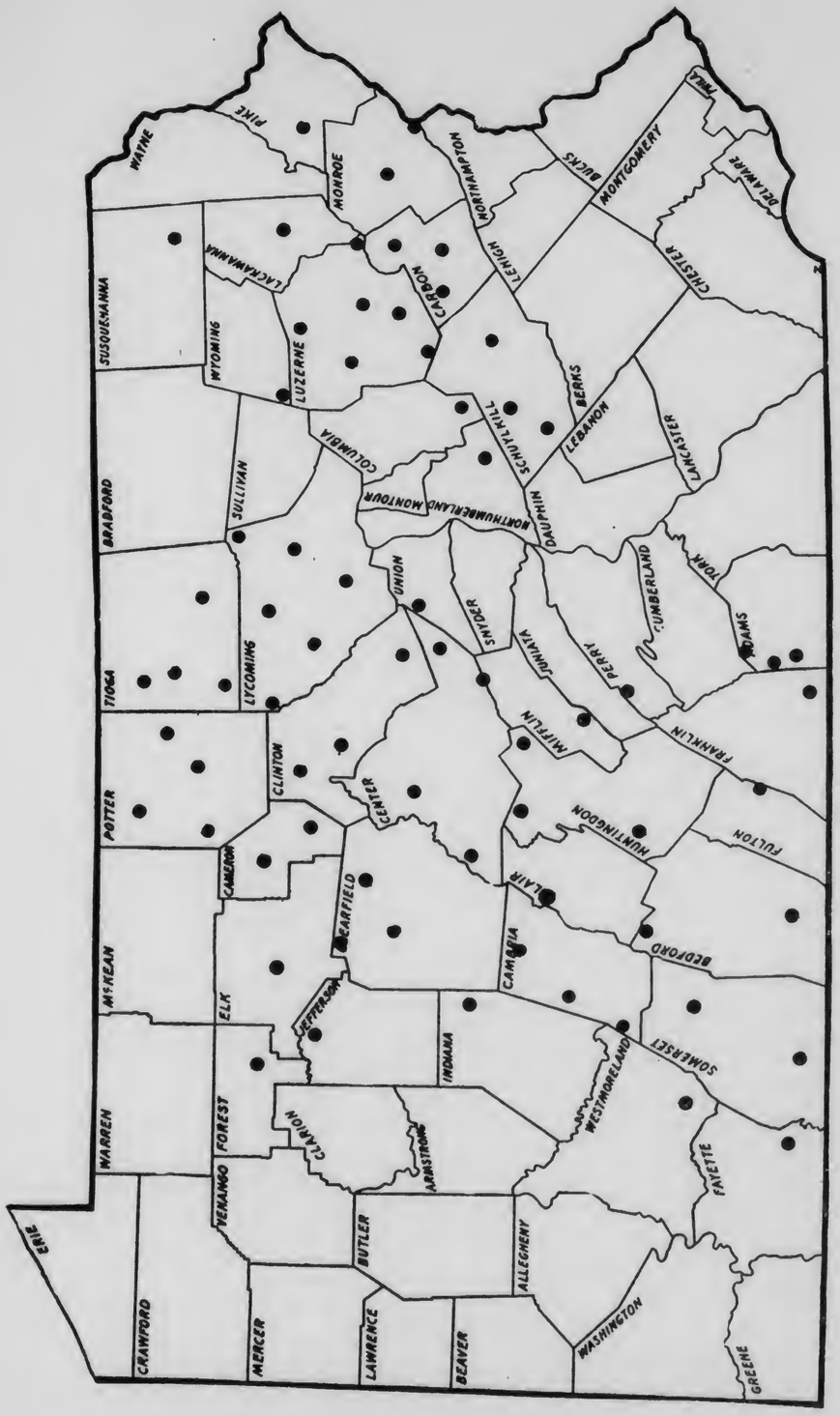
BULLETIN 27

R. Y. STUART, COMMISSIONER

1922

PENNSYLVANIA DEPARTMENT OF FORESTRY

PREVENT FOREST FIRES — IT PAYS



FIRE OBSERVATION TOWER SYSTEM IN PENNSYLVANIA

FOREWORD

THE FOREST IS YOUR FRIEND.

THE WATER YOU DRINK COMES FROM IT.

NOTHING YOU USE OR WEAR COULD BE YOURS WITHOUT THE FOREST'S HELP.

THE STATE FORESTS ARE YOUR PLAY-GROUNDS. THEY ARE WIDE OPEN FOR YOU TO FISH, HUNT, AND CAMP.

OUR FORESTS ARE ALMOST GONE.

THEY WILL GROW AGAIN IF FIRES ARE KEPT OUT.

THE FOREST FIRE IS YOUR ENEMY.

GIFFORD PINCHOT.

INTRODUCTION

This guide has been prepared for Pennsylvania Boys. Because many of them have given valuable assistance in forest protection, the Department of Forestry believes they are anxious to do effective work in forest fire extinction. This booklet is intended, therefore, to tell some of the interesting facts about forest fire, how it burns, how it may be prevented, and how it may be put out.

FORESTS NECESSARY IN PENNSYLVANIA.

Forest fires must be prevented because the future prosperity of Pennsylvania depends upon her supply of wood. We cannot get along without it—nothing we eat, nothing we wear, can be supplied without wood. We cannot have this wood supply as long as fire endangers every acre of growing trees, and burns about 200,000 acres of forest land every year. We must provide for our future needs, therefore forest fires must be prevented.

HOW FOREST FIRES START.

Much might be written about how fires start and why they start. The kinds of fire may be grouped under two headings— (1) Non-preventable; (2) Preventable.

CLASSIFICATION OF FIRES:

1. Non-preventable.
   Instances: Lightning and spontaneous combustion.
2. Preventable.

(a) Incendiary—Fires set maliciously. (Back-firing in good faith does not fall within this class.)

Instances: Burning of another's woodland for one's own advantage.

(b) Railroads—Fires caused during the construction, operation, or maintenance of railroads, except those used in lumber operations. These fires are of two classes: From engines, or from the right-of-way.

(c) Lumbering—Fires caused by lumber operations.

(d) Burning Brush and Litter—Fires caused while clearing land except those mentioned above.

(e) Transients—Fires resulting from the carelessness of campers, picnickers, surveyors, laborers (except railroad and lumber operations), hunters, automobilists, and other travellers or workers in the forest.

(f) Miscellaneous—Fires, the origin of which is known, but which cannot be classified properly under any of the heads mentioned above.

Instances: Tractors, fireworks, breaking of electric transmission lines, etc.

(g) Unknown—Fires, the origin of which cannot be fixed so as to include them under any other head.

NUMBER OF FOREST FIRES BY CAUSES.

Year.	Railroads	Brush Burning	Incendiary	Transients	Lumbering	Lightning	Misc.	Unknown	Total
1915	274	105	120	136	28	19	37	382	1,101
1916	270	55	95	182	44	10	45	312	1,013
1917	756	179	127	200	45	3	52	731	2,087
1918	402	115	118	99	46	6	162	587	1,625
1919	250	77	76	118	28	3	20	378	950
1920	553	104	128	218	44	4	25	521	1,597
1921	979	120	96	121	13	10	119	917	2,384

This table of causes of forest fires in Pennsylvania shows:

1. That very few fires are caused by lightning.
2. That carelessness or neglect by someone causes more than ninety-nine per cent of the forest fires. No matter what the immediate or apparent cause may be, the real cause can be traced in most cases to carelessness or neglect.

   Sparks from railroad and other engines cause the greatest number of fires. The engines have not been properly equipped with spark arrestors and closed ash pans or have been carelessly operated; safety strips have not been provided or track patrolmen have not put out the sparks.

   Smokers are probably responsible for the next largest class of fires. They are careless with matches and burning tobacco.

   Campers are careless or negligent with their camp fires, either in building them or in leaving without putting them out.

   Those who burn brush do not take precautions to keep their fires constantly under control.
3. That some fires are set purposely.

PREVENT FOREST FIRES.

Pennsylvania will continue to have forest fires, until every person knows the value of forests and realizes the great damage caused by carelessness with fire. The first thing necessary, therefore, in order to save the forests is to have every one learn how forests benefit them and how impossible it is to live without forests and forest products.

Persons who smoke while walking or riding through the forest should not drop fire upon the dry leaves or grass. They must take no chances with matches, cigars, cigarettes, or pipes.

Those who build fires in the forest should first clear a big space; should keep the fire small; should not build it against a log or hollow tree; and should be sure to put out every spark before leaving.

Persons should burn brush, while clearing fields, woods, or fence rows, only when the woods are damp, and then only with sufficient help and under advice of a forest fire warden.

Those who operate wood or coal-burning engines in or near forests must insist upon equipment which will not permit sparks to escape.

Persons who persist in their carelessness or who purposely set fire to the forests should be punished. In order to do this, local officials and neighbors should be interested so they will help prosecute the case.

REMOVE FOREST FIRE HAZARDS.

Some fires are started because of an unnecessary accumulation of inflammable material at places where the use of fire cannot be prevented. The size of forest fires may be greatly increased because of these accumulations. The removal of this material from roadsides, railroads, sawmills, and engines is important.

The Chief Forest Fire Warden of the Pennsylvania Department of Forestry has issued the following statement concerning hazards that must be removed:

"Under the provisions of the Act of June 3, 1915, it is my duty as Chief Forest Fire Warden to declare a public nuisance any property which, by reason of its condition or operation, is a special forest fire hazard, and, as such, endangers other property or human life. In Section 1004 the Act further provides that every person or corporation refusing to comply with an order of the Chief Forest Fire Warden for the abatement of a nuisance, under this act, shall be guilty of a misdemeanor, and upon conviction thereof shall be sentenced to pay a fine of not more than One Hundred Dollars, or undergo imprisonment not exceeding one month, or both, in the discretion of the court * * * and every day's continuance * * * shall be a separate and distinct offense.

"1. Engines of all kinds not provided with effective spark arresters, ash pans, or other equipment to prevent the spread of fire when such engines operate within 200 feet of woodland or of other inflammable property likely to spread fire to woodland.

"2. Inflammable debris within 100 feet of a steam railroad track. This includes uncleaned woodland which requires cleaning for the completion of a safety-strip along the railroad.

"3. Inflammable debris located within a radius of 150 feet from a sawmill or other engine operating within woodland or operating within 150 feet of woodland.

"4. Inflammable debris within 25 feet of the edge of the traveled part of a public highway, the clean road bed of an electric railway, or of any other frequented highway.

"5. Slash from lumbering operations without a protective strip of 100 feet adjoining woodland.

"As used above, debris means such material as slash, mowings, or other wastage, and accumulated forest litter.

"It should be understood that in unusual or extraordinary cases the Department is not restricted to action based upon the conditions cited above. Its duty is to invesigate independently, or upon report, all forest fire hazards and to base its action upon the conditions in each particular case.

"When hazards within the provisions of the Act are found, notice will be given to the responsible parties that they must be removed. If after notice duly given they are not removed, it is my purpose to declare them public nuisances and to recommend that action be taken under Section 1004 of the Act."

SAFETY-STRIPS: Along railroads, safety-strips from 100 to 200 feet from the rails may be lightly burned. At the outer edge of this strip a trail of bare soil may be dug or plowed. Several fresh furrows should parallel the railroad in the spring and fall along grass and waste fields. Owners of land along railroads should be urged to take some precautions against fire, and not depend entirely upon the railroad company.

Burning should be started at the bare soil strip and proceed toward the track. Extreme care is necessary to prevent the fire getting beyond control and doing damage instead of good.

All slash, brush, and rubbish that will burn, or in which fires may start, within 150 feet of a railroad track ought to be disposed of by burning or be otherwise removed. Similarly such material should be removed from a twenty-five foot strip along traveled highways and electric railways. If such material is not allowed to accumulate, careless travelers will not cause so many fires.

Around sawmill and other engines which are operated in or near forests all inflammable refuse should be removed within a circle having a radius of at least 150 feet, with the engine as the centre.

In the woods, when the trees are cut, everything in the tree that can be used should be taken out, leaving only the small branches.

These may be burned in piles or scattered over the ground where they will soon decay. All dead trees, standing or down, should be used if possible. Decaying trees, crooked trees, and trees which are of little present or future value should be cut before the sound and valuable trees are cut. Keeping the forest free from such rubbish helps to prevent the start and the spread of forest fires.

By keeping roads and trails through woodlands open and at least a foot of their surface bare to the mineral soil, fires may be attacked promptly and kept within a small area.

FIRE EXTINCTION: Next to preventing fires, it is important to extinguish at once all fires that may start.

The fire, when discovered, should be reported immediately, and should be attacked promptly by persons who know how to fight it. The fire fighters should be organized, but one person can do much by hitting the line of fire wherever possible and sticking to it.

PRESENT FOREST FIRE ORGANIZATION.

WARDENS: The State of Pennsylvania has an organization of forest fire wardens who prevent and extinguish forest fires. The State's Chief Forest Fire Warden is in the Department of Forestry at Harrisburg. He directs the fire prevention work of the Foresters in charge of the twenty-four districts into which the State is divided. The District Foresters supervise the activities of more than 2,800 local and special forest fire wardens.

TOWERS: There are 111 observation stations in the forested areas of the State. During fire seasons watchmen, or lookouts, are on these towers. Towers are connected with telephone lines, so

that fire-fighting crews may be summoned promptly. There are also a number of men appointed to do patrol duty in dangerous seasons. The special duty of towermen and patrolmen is to discover and report the locations of fires.

This organization is constantly on the alert to detect, to report and put out forest fires. The effectiveness of the organization depends upon the cooperation of the citizens with the wardens. These citizens report forest fires to the nearest wardens who will go promptly to extinguish them. This may be done by telephone, telegraph, messenger, bell, whistle, or by other methods.

In addition to the Foresters, Forest Rangers, and Forest Fire Wardens of the Department of Forestry there are other persons who are cooperating in forest fire prevention:

State Game Wardens are also forest fire wardens.

State Policemen are forest fire wardens.

State Highway employes furnish men, tools, and trucks, for fire extinction.

Rural mail carriers are designated forest fire patrolmen by the United States Postmaster General, with instructions to report fires promptly to the nearest local forest fire warden.

Telephone companies in Pennsylvania instruct their operators to refer forest fire calls directly to a forest fire warden.

Railroad companies have had section foremen who are located near woodlands made special forest fire wardens.

Individuals and corporations have had regular employes appointed special wardens.

Individuals and organizations, particularly the Forest Protective Associations, Boy Scouts, Fish and Game Associations, Chambers of Commerce, etc., cooperate with the Department of Forestry.

FIRE CREW: Usually wardens need help to put out forest fires. It is important that those who help know where to go and what to do. A few people well-organized into a crew and working in cooperation are of much more value at a fire than a large number disorganized and without method in their work.

A good crew is made up of a foreman, who should be a forest fire warden, or some one designated by him. There should be one or two axemen according to location of the fire to remove brush or logs from line of attack; three or four men with rakes to clean a trail, exposing mineral soil, from which to start a back-fire, or up to which the fire may burn and stop; a torchman to start a back-fire; three or four guards to watch the back-fire

and see that it does not throw sparks across the trail, and one man or boy to carry water.

The crew members should respond promptly and assemble at a prearranged place. Each man should have the same work to do every time he goes on the fire-line.

FIGHTING FOREST FIRES.

PROMPT ACTION: The efficiency of a warden and his local organization is determined by the time which elapses between the start of the fire and the first attack. There should be no excuse for delay after a fire is known to exist. Quick action reduces expense, loss, hard work, and prevents big fires. Small fires are easily subdued. It is true that fire fighting is more effective in the evening, night, or early morning, but it is a criminal waste to wait until that time to begin.

TRANSPORTATION PREARRANGED: The warden should have arrangements made in advance of the fire season for transportation of fire fighters. It is not difficult to arrange with automobile owners and drivers to furnish cars on short notice for this kind of service. But the plans must not be delayed until a fire starts.

CALL OF CREW: If a fire-fighting crew is well organized its members can be brought together in a short time when a prearranged signal is sounded. This signal may be a local alarm, bell or whistle. It should be understood where the crew is to meet. Additional help, if needed, should be summoned by telephone. In some towns, arrangements have been made to sound forest fire alarms on the usual municipal fire bell or whistle. A distinctive forest fire alarm has been agreed upon so there will be no confusion.

Ordinarily, it is not wise to call out more than two or three crews at the first call, unless the fire already has a good start, or that it is likely to become dangerous in a very short time. On the other hand, it is always well to remember that it is better to have one or two crews too many than to be one crew short. If, after reaching the fire it is found that more men will be needed, no time should be lost in sending for additional forces. If necessary, nearby fire wardens should be notified by telephone or telegraph.

ORGANIZED WORK: At a fire, the forest fire warden is in charge. He must keep the crew under his control at all times. Those who go to a fire should report to a warden. If the warden is absent, a foreman should be selected. The proper control of a crew requires skill and judgment. Too many bosses in a fire-fighting

crew slow up the attack. Determine upon a method of attack, and follow it fast and hard. If more than eight or ten men are present, the force may be divided, with a foreman in charge of each crew. Each crew should be stationed at some important place on the fire line. In this way the fire may be more effectively controlled. By putting each man to the work he can do best, the whole force will be used to best advantage. For example, at a light surface fire one crew may be sent along the fire line with extinguishers or sprayers followed by men with rakes, shovels, hoes or brooms to clear the ground of litter and prevent the fire from crossing the line. Another crew may be sent for water to keep the spray tank supplied. Or in case of a fire sweeping through brush and timber, if back-firing is resorted to, the foreman should go ahead and decide on the line from which the back-firing is to be done; one or two axemen should follow, then several men with forked sticks, rakes, brooms, hoes, shovels, mattocks, etc., should clear the trail down to bare earth. One torchman, to set the back-fire, is usually sufficient. He should be followed by guards, who are sometimes equipped with sprayers or chemical extinguishers, to prevent fire crossing the trail. The rear guard must be the most reliable man of the crew for he must see that the fire line is safe before he moves up the line.

CARE OF CREW: Forest fire fighters need water, food, and rest. Everyone going to fight a forest fire should take a lunch along. The other actual needs of the men should be supplied as far as possible. If any men are allowed to go home for food or supplies they may not return promptly. The crew should work in shifts if necessary.

LOCATION OF FIRE. It is important to know where the fire is before starting out. Some one, usually the warden, should telephone promptly to persons who can see the fire or smoke from it. The location of the fire can best be obtained from the watchman on the nearest fire observation tower. False alarms are sometimes sounded, but it is better to respond to a false alarm than to let a fire get well started.

ATTACK: Upon arrival at the fire, the person in charge should find out two things as soon as possible: (1) which part of the fire is advancing most rapidly; (2) the location of forest growth or other valuable property which is likely to be destroyed. No two fires are alike, even though they may occur under similar conditions, and in deciding the method of attack the warden, or crew leader, is required to apply his knowledge of conditions and his skill in handling his men. The two things for which he must work, therefore, are

limitation of the area burned-over, and control of the damage to timber. He must decide quickly whether to place his men between the fire and the valuable forest growth or in front of the rapidly-spreading flames. In the majority of cases the latter is the logical course. The warden should judge the speed of the fire and decide how far ahead of it he will start his attack. He should know the distance to the nearest fire-break, such as a trail, road, brook, field, etc.

It is assumed the warden will be prompt, and that he and his crew will arrive while the fire is small. But if for any reason a warden must attack a large fire he should take the men to the front, start the attack at a favorable place, and then size up conditions, going entirely around the fire if necessary. No time must be lost, but a half-hour spent in making good plans after a complete investigation, may determine the success or failure of the fight.

"For instance, to beat out a hot fire line in the woods within a short distance of a road in a dry time is generally mistaken judgment, since the fire is exceedingly likely to break over again as it would not with the bare soil of the road to help control it; or spreading a limited force of fighters on a long fire line, part of which is headed toward a natural barrier, and part of which is not, weakens the work where most needed and spends effort where unnecessary.

"Fire can be headed or directed into natural barriers like swamps, clearings, old burns, hedges, etc., by choosing which portion of the head fire to attack first, when the whole fire line cannot be met promptly and effectively because of its magnitude or of lack of help. Judgment used in this way is worth more than hours of labor."—New Jersey Circular.

METHODS OF FIGHTING.

There are many methods of fighting forest fires. Some are good and some are not. Some men think their method is the only correct one. A good warden is always ready for useful suggestions, and is willing to give them fair trial. Methods of fighting vary with the character of the fire, type of the forest, condition of the atmosphere, strength and direction of the wind, rapidity of the fire's advance, topography, and material on the ground.

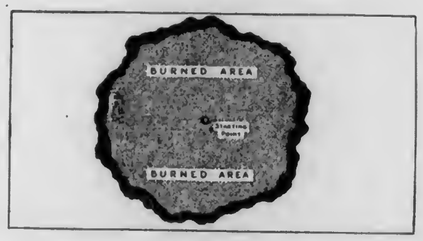
TREE FIRES: These are stopped by shutting off the air which makes a draft through the hollow trunk. Close the hole at the ground if possible with dirt. If this cannot be done, the ground around the burning tree should be cleared, and the tree should be felled. The fire can then be smothered inside and outside. If water is available, the fire may be put out with force pump or sprayer or chemical extinguisher without felling the tree. Dead snags in forests

should be felled as a matter of fire prevention as well as for the benefit of the forest.

SOIL FIRES: These fires can be stopped only by digging deep enough to prevent their spread. The ditch, as well as the surface should be flooded if possible. This, however, is seldom possible. Where a soil fire has a good start it may be cheaper to blast a ditch than to dig one. Well-placed dynamite will do effective work in a short time.

CROWN FIRES: We have few crown fires in Pennsylvania. Natural conditions as to topography and growth are the best means of stopping any that may occur.

SURFACE FIRES: This is the kind of fires which occur most frequently in Pennsylvania. If there is little wind the flames may be put out by beating with branches (pine preferred), shovels, and wet burlap. Fire fighters should beat the flames with a side sweep toward the fire to avoid spreading sparks. Sweeping with old



How a Forest Fire Burns When There is no Wind.*

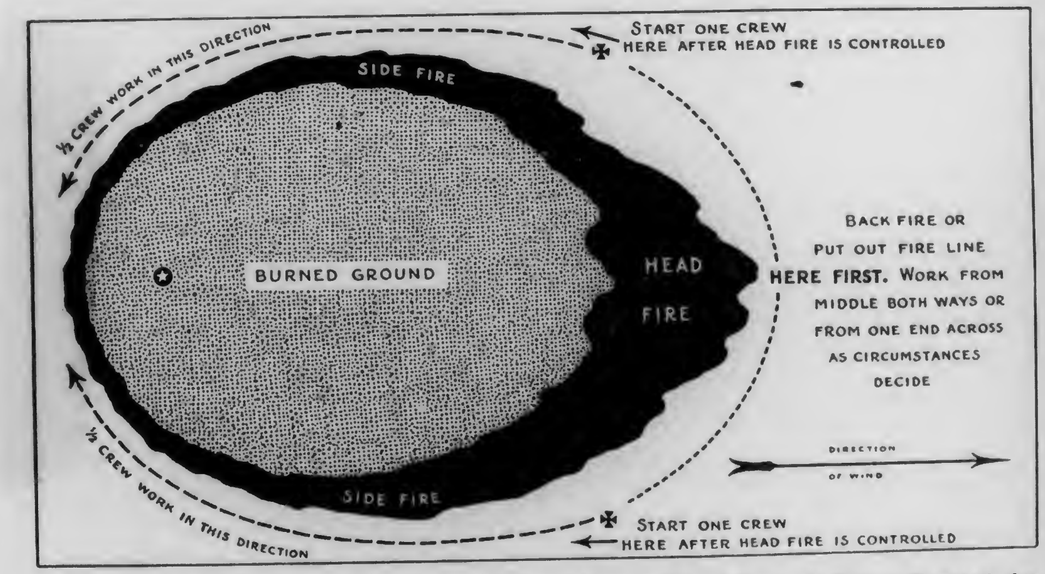
brooms, brooms made of branches, or steel brooms, is better than beating. The burning material may be pushed back upon the burned-over ground with rakes, sticks, forks, or other tools. The idea is to separate the burning material from that not yet afire. Water is always effective, but too frequently dependence is placed on it, and when it is not available fire fighters seem to be at a loss to know how to make their attack. The fire can be smothered by throwing on dry or moist sand or dirt. If it is possible to plow, a furrow may be thrown up quickly to restrict the spread of the fire.

Sometimes small or lightly-burning fires are beaten out. If no trail is cleared to the bare ground entirely around the burned area, here and there small pieces of smouldering wood may be fanned into flame and the fire may again break out. **It is always a safe practice to make a clean trail with exposed mineral earth entirely around the burned area.**

*This cut and those on pages 11, 13, 17, and small one on 16 from New Jersey circular.

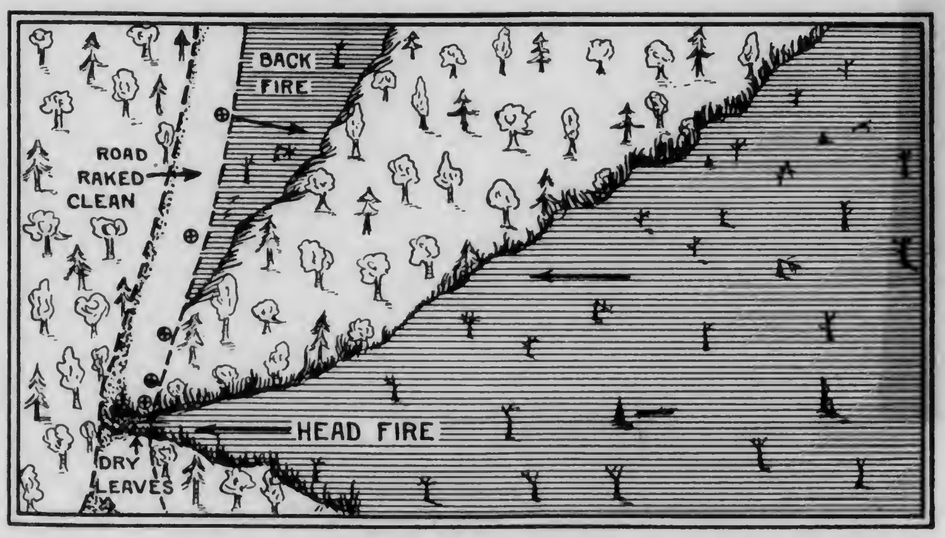
Chemical extinguishers are sometimes used. Careful tests have been made by foresters and it has been found that the chemical spray is of no more value in the woods than is plain water with a little force back of it. This force can be supplied by a foot pump, or by air pressure, as in the ordinary fruit spraying devices. Sprinkling water in front of the fire reduces the force of the flames and permits close beating and raking. To be effective, considerable water is required when it is sprinkled directly on the flames. Water is used to the best advantage when the stream is thrown at the ground immediately in front of the flames. The water and force combined will stop the flames' advance. It is also satisfactory to spray water against the base of the flames from the rear particularly if there is much smoke.

BACK-FIRING: When the wind is strong or when the flames are in slash, fallen logs, dead ferns, bracken, or grass, fire becomes so intense that it is unsafe and impracticable to attempt close attack. Back-firing is resorted to in such cases. It should be remembered that fire is a dangerous force and that when fire is fought with fire extreme care and keen judgment must be used. If a fire starts some area will be burned over and some growth will be damaged, but in order to reduce the damage as much as possible some additional sacrifice may have to be made by starting a back-fire. The area to be covered by the back-fire should, however, be kept as small as is practicable.



The Correct Way to Attack Any Forest Fire. Always Work From in Front Toward the Rear. Stop the Head Fire First and Work Far Enough to Each Side So That the Side-fire Cannot Work Around to Make a New Head-fire.

Frequently under excitement, the speed at which the original fire is traveling is misjudged and a back-fire is started too close to it or too far in advance of it, usually the latter. Occasionally a back-fire has been set at the foot of a mountain along a road to stop a fire just coming over the top. Sometimes a land owner has set a back-fire along his property line without regard to where it may go or where the original fire was. Indiscriminate back-firing cannot be



The Incorrect Way to Attack by Back-fire. The Head-fire Reaches the Fire-break and Jumps Over it Before the Back-fire Reaches the Point of Advantage.

condemned too strongly. A lack of information regarding the locations of fire-breaks already established and the topography may result in errors in back-firing. (Everyone should be on the watch for such cases and report them.) Such errors should be reported to the person in charge of the fire-fighting crews. After the necessity for starting a back-fire has been determined—and not before—the back-fire should be started as close to the main fire as practicable. Sometimes back-fires do not stop the original blaze. In that case the crew must drop back to a second line of defense and renew the attack. The retreat should be made promptly and the new fight started at once from the most advantageous position.

Fire burns slowly down hill, and rapidly up hill. Therefore, a good place to start a back-fire is just over the brow of a hill up which a fire is advancing on the opposite side. Fires burn slowly against the wind and rapidly with the wind. The heat and draft from the advancing fire attracts the heat from the back-fire and hastens the advance of the latter when the two are approaching. Observation of the force and direction of the wind will give warning in time

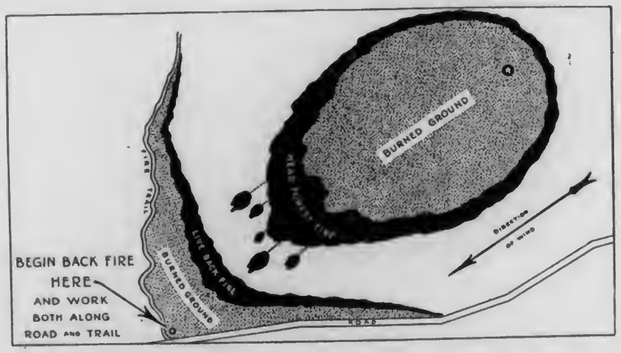
to protect the men. It will also indicate whether a quick advance should be made to another point that is threatened by the flames.

A back-fire should be started from a fire-break, such as a road, stream, or other natural barrier. In case a fire-break is not found at

A Back-fire should be Started at a Road, an Open Trail or a Stream.

the proper place for back-firing, one must be made. The ground should be cleared so that the damp mineral soil is exposed. Such a trail can be made very quickly even through brush with forked sticks, if no other tools are available. Of course, axes, brush hooks, rakes, hoes, shovels, and brooms are better tools.

Usually the smoke is thickest, fighting is most uncomfortable, and danger of spark-spreading is greatest in line with the draft of the fire. The back-fire should be started at this point, and every man available is needed there. The back-fire should be started at the



Where an Angle Can be Used, the Back-fire May Have to be Longer, But the Area Burned by the Back-fire is Reduced. Be Careful that the Side-fire Does Not Come Up Before the Wings of the Back-fire are Safe.

lower point of a V, the sides of which are open enough and extended far enough to include the header of the advancing fire. The whole crew is available to attack promptly the spot fires in case sparks cross the fire-break. As soon as the header is halted the side lines of the back-fire may be drawn in close to the side lines of the main

fire and continued parallel to them, or even run into them. The rest of the fire-line may be beaten out. Remember, however, that a trail cleared to mineral soil should extend entirely around each fire to make it safe. The crew, even if small, should be divided at the point of the V, with a few more men on the side which should be advanced more rapidly or on which the danger is greater because of the wind.

A satisfactory arrangement of crews is as follows: the warden or foreman directs the course and location of the fire-break, if one must be made. He is in charge of the whole fire-fighting force and should urge each man to do his best. According to the amount of brush to be cut one or two axemen or brushcutters follow the warden. Four men with small wooden rakes, or some other tool, one

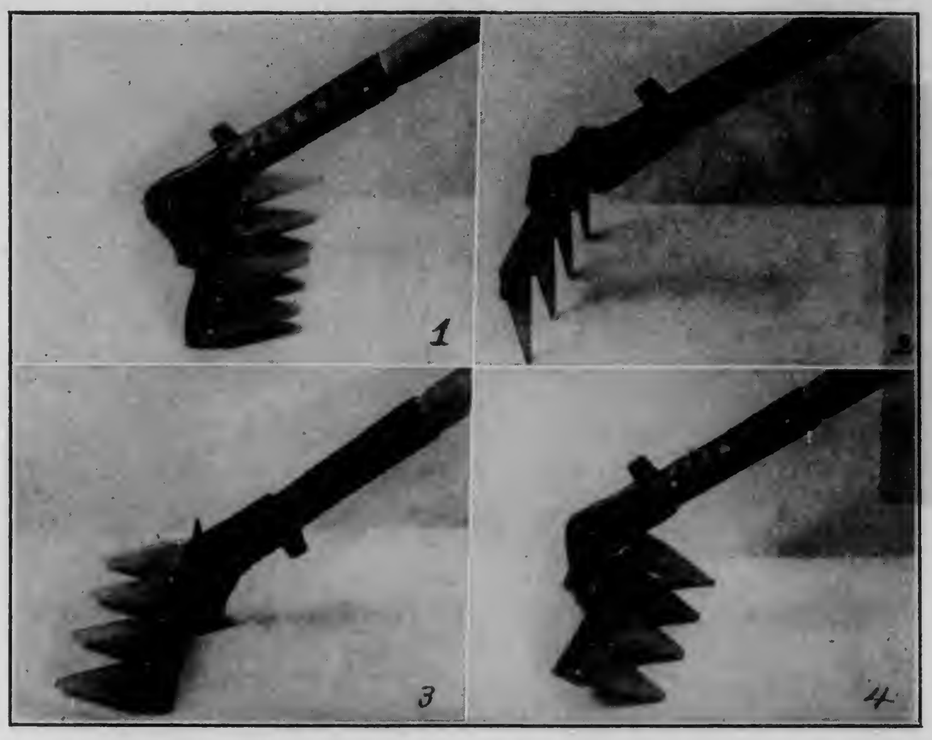
A Wooden Rake Makes a Clean Trail.

working close to the other, make a clean trail, exposing the mineral soil, raking the material to the side away from the fire unless it is needed to start a back-fire. Next comes a man with a torch. He must not set fire too rapidly for the nearest raker, nor for the guards who follow him. If the torchman sets fire too rapidly for the rakers the heat may drive them off their course, and if too rapidly for the guards, the fire may not burn away from the trail fast enough to permit their moving up with the torchman. As a result sparks may blow across the trail where there will be no one to discover and stamp them out immediately. Four alert and active guards can take care of a long line of back-fire. They should have three-gallon spray tanks and a continuous supply of water. They should have also a rake or broom. Pine brush may be used in the absence of a better tool. The rear guard must be the most dependable man in the crew for he must determine when the line is safe and must not leave it until it is safe. It is important that someone who knows the woods after dark should be detailed to carry water.

Back-fires Are Started With Torches—

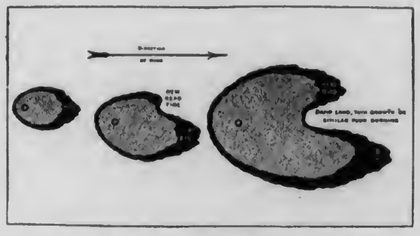
Some authorities do not recommend a back-fire except as a last resort. There is no reason, however, why the principles of back-firing may not be used at every fire, no matter how small. Some persons recommend that a fire should be attacked where it is first met. This point, however, may be where it is doing the least damage. The essential point in forest protection is not merely to put a fire out, but to put it out in the shortest possible time, to restrict it to minimum area and damage. Therefore, it should be attacked where it is making most headway or where it is doing most damage. Some recommend attacking a fire on the side-line near the front. They contend the front is gradually narrowed and weakened until it is

easily subdued by reducing the amount of fire and draft. There is some merit to this method, but it is a makeshift.



The Rich Fire-tool, Which Can Be Adjusted Into Four Positions, is the Most Effective Fire-fighting Instrument.

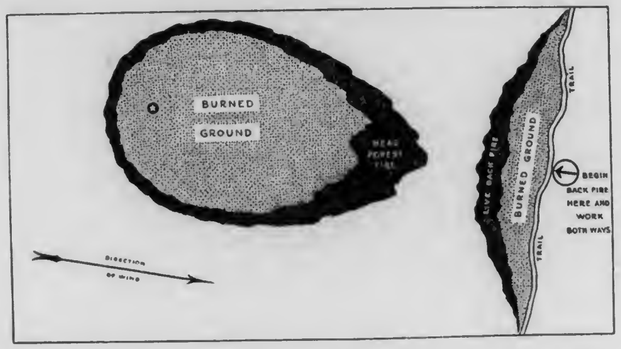
When fire runs into rocks, or burns over a very rocky area, it may be necessary to do considerable quarrying to establish a safety trail around the burned area. In such cases it may be necessary to start a back-fire at the outer edge of the rocks and let the fire smoulder under them. This should be done only after careful consideration of expense and damage.



How a Side-Fire May Develop a New Head-fire.

In rough hilly country several headers may develop because of topography. The size of the force available will determine how

these headers should be handled. After one header has been subdued a change of wind may cause this situation to arise. It is always poor policy, therefore, to delay the attack on both side lines. As long as a flame burns prompt and continuous action is required.



If Worked Straight Across the Head-fire, the Back-fire Must Be Long Enough to Check Not Only the Narrow Head-fire, But Also the Full Width of the Fire Behind.

The foregoing illustration is described by a forester as follows: "It is useless to try to head off a fire ascending a steep slope. My method has been to start a back-fire at the top of the slope, dividing my men into two crews, each running a line away from the other, at right angles to the direction of the oncoming fire until it is safe to run the line down the slope in the direction of the fire, flanking it and finally catching it in the rear." This is a satisfactory method of attack.

Occasionally a back-fire is started at the bottom and diagonally to the slope of a hill. As a result, usually the uphill draft causes the fire to move more rapidly than the men can handle it, and it sometimes gets away. If this method is necessary, the back fire should be started at the top and worked down, running directly with the wind or at an angle to it. It pays to take the time to walk up a hill before starting the back-fire.

It is advisable to do some thinking after a fire has been extinguished. Review the plan of attack and consider whether better plans might have been made so that the fire could have been more quickly and more easily extinguished.

THE LAST SPARK: No fire is out until the last spark is dead. Sometimes wardens and men leave as soon as the flames have been extinguished, with the result that frequently the fire has started up again at one or more places. Then the fire has to be fought again; it is larger, is harder to subdue, takes more time, costs more, burns

over more area, and does more damage than the first fire. No chances should be taken with its breaking out a second time. All but the most dependable men should be discharged. The burned area should be inspected to see that there is no danger of fire creeping across the trail which ought to have been cleared around the burned area. Threatening brands should be thrown far into the burned area; logs and branches holding fire should be rolled over and sprinkled with water or covered with dirt until they are safe. Punky stumps should be examined and broken apart to see that they can give off no sparks. Burning snags standing within several hundred feet of the unburned area should be cut down. Every precaution should be taken to prevent a recurrence of the fire. If a fire has been put out during the day, the tract should be patrolled until the wind goes down in the evening, or until dew falls. If the fire has been extinguished in the morning and there is the least danger of its starting again, the area should be patrolled until the next afternoon or evening.

No fire is out until the last spark is dead.

FOREST TREE PLANTING

WHEN TO PLANT
WHERE TO PLANT
WHAT TO PLANT
HOW TO PLANT

By
John W. Keller,
Chief, Bureau of Silviculture

BULLETIN 28

PENNSYLVANIA DEPARTMENT OF FORESTRY
ROBERT Y. STUART, Commissioner
1922

INTRODUCTION

THERE are 13,000,000 acres of timberland in Pennsylvania. A large part of this area is not producing what it can and should. If fires are kept out, many acres of it will come back with a satisfactory growth of trees, but there are 3,000,000 acres that are absolutely idle and should be planted with trees at once. Without planting, it will require half a century for this idle land to be satisfactorily restocked with trees, and in this time the area is capable of producing enough timber to supply the entire State of Pennsylvania for twenty years at the present rate of consumption.

Wood is vitally essential to our people, and the rapidly growing industries of our State. None of us can get along without it. The country dweller can get along with less than the city dweller because it not only takes wood to grow food but, after it has grown, it must be packed in wooden boxes or barrels and transported in wooden cars or wagons before the city man can eat it. The lack of wood will mean physical and industrial decay to our own strong and properous commonwealth.

The State of Pennsylvania recognizes its responsibility in making every acre of idle forest land produce and will gladly supply you, free of charge, with trees for reforestation.

Forest tree planting methods that have been tried and are successful are discussed on the following pages.

FOREST TREE PLANTING

WHEN TO PLANT

FOREST tree seedlings should be planted in the spring after the frost has come out of the ground and before the new growth has started, or, in the fall before the ground is frozen. Whenever possible, planting should be done during the spring because the trees will begin to grow at once, and usually more of them succeed.

If labor is not available in the spring, planting in the fall can be undertaken with reasonable assurance of success under the following conditions:

First, when the soil is not heavy clay and the danger from heaving will be slight.

Second, when the area is not a "frost pocket," i. e., subject to severe frosts.

Third, when the planting site has a northern exposure and the frost leaves the ground late in spring.

Fourth, when the trees to be planted start to grow early in spring, such as American larch, European larch, Japanese larch and wild black cherry.

One tree-planting enthusiast wrote:

"I am planting for timber. It is better than bonds."

WHERE TO PLANT

IDLE lands that are not needed for, or not adapted to, agricultural or other more important uses, should be planted with forest trees. These lands usually come within one of the following classes:

Class 1. Cleared lands, such as abandoned fields and worn out pastures, eroding banks, slopes and gulleys, odd and unused corners about the farm, along highways and water ways.

Class 2. Worn out farm woodlots which are growing up with undesirable trees or do not support a satisfactory stand of valuable young growth.

Class 3. Areas on which a windbreak is needed to protect buildings, live stock, orchards and crops.

Class 4. Burned over areas covered with bracken, sweet fern, aspen and fire cherry upon which small seedlings of desirable trees are not coming in naturally.

Class 5. Scrub oak barrens on which growth of oak, chestnut or other valuable trees are not present in sufficient quantities to insure a satisfactory forest crop. These areas should be planted immediately after the fire has killed the scrub oak sprouts. If planting is done under sprout growth the planted trees will often be killed by the dense shade.

Class 6. Areas upon which the chestnut has been killed by the Chestnut Blight and a satisfactory stand of other valuable forest trees has not come in.

More than 34 million trees have been planted on State Forests during the last twenty-one years. The plantations now cover 22,500 acres.

COST OF PLANTING

A PLANTING crew of two men can usually set out from 1,200 to 1,600 trees in a ten hour day. If the trees are obtained from the Pennsylvania Department of Forestry the packing charges at the nursery will amount to approximately 75 cents per thousand trees, and the transportation charges will cost about 35 cents per thousand trees. Under average conditions the total cost of planting an acre with forest tree seedlings should not be more than $12.00.

WHAT TO PLANT

IT is best to plant trees that grow naturally in a locality. These trees will usually thrive under similar conditions when properly transplanted. Large plantations of foreign trees should not be made unless experiments have proven that they will thrive in the places where they are to be set out. Thirty years of experience in planting European and Japanese larches, Norway spruce and Scotch pine in this State indicates that these trees can be planted on properly selected sites with reasonable assurance of success.

More evergreens will be planted than hardwoods, because they are more easily transplanted. They usually grow faster, are more attractive, produce a larger amount of lumber per acre, and their wood can be used for general purposes and is in large demand. Nevertheless, the wood of walnut, ash and oak is so valuable for special uses that planting of them is recommended on moist, fertile soils which are not more valuable for agricultural or other uses.

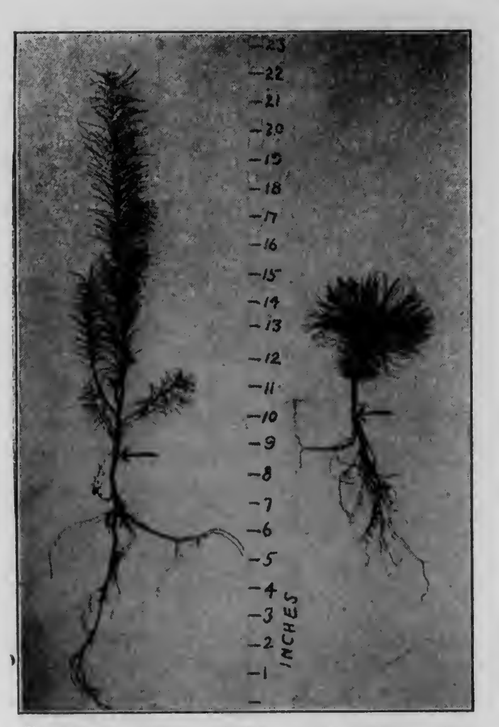
The most important factors in determining the kind of trees to plant are soil and moisture. The greatest care should be used in selecting the kind of trees that will thrive under the conditions existing on the proposed planting site. Any of the trees listed in this bulletin are recommended for planting in Pennsylvania.

AGE AND SIZE OF PLANTING STOCK

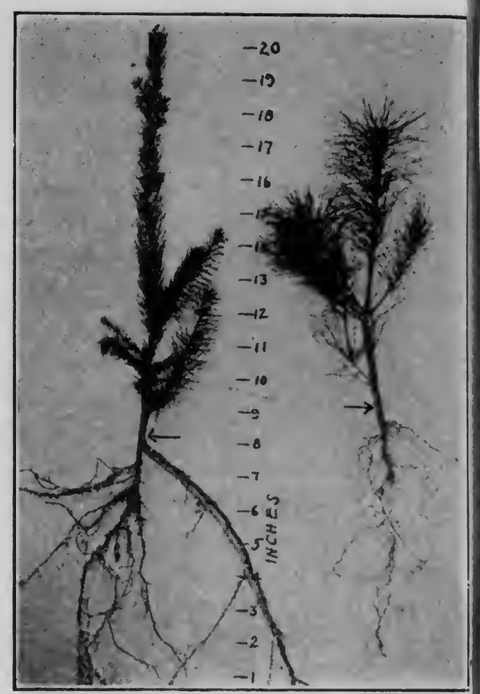
THE age and size of the planting stock depends largely upon the condition of the planting site. If no heavy sod, dense weeds, or sprouts grow on the area, trees from 4 to 8 inches in height may be planted. This will result in the largest number of living trees at the lowest planting cost. The larger the planting stock the greater will be the cost of planting, and the harder it will be to get the trees to grow. Consequently small planting stock should be used unless there is good reason for doing otherwise.

As a general rule, trees of the following ages are the right size for the usual planting site in Pennsylvania:

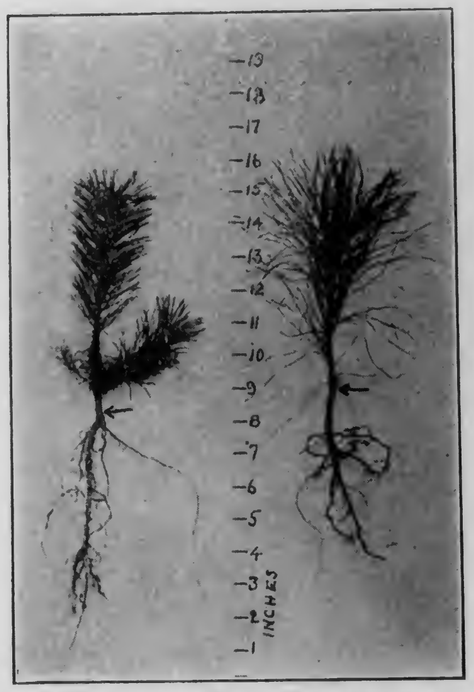
White pine	**2 or 3 yrs.**	**Walnut**	**1 yr.**
Pitch pine	**2 yrs.**	**Ash**	**1 yr.**
Red pine	**2 or 3 yrs.**	**Black locust**	**1 yr.**
Norway spruce	**3 or 4 yrs.**	**Red oak**	**1 yr.**
Larch (Japanese or European)	**2 yrs.**	**Sugar maple**	**1 yr.**



Japanese larch (left) and white pine (right), two years old.



Norway spruce (left) and white pine (right), three years old.



Pitch pine (left) and Scotch pine (right), two years old.

A bunch of 50 white pine seedlings, tw years old, ready for packing and shi ping.

HOW TO PLANT

IMMEDIATELY upon receipt, the trees should be taken to the place where they are to be planted. If they cannot be set out the same day they should be "heeled in." For this purpose select a place in well-drained soil which is not stony and where water is available. An open trench should be dug with one side almost vertical. Take bunches of trees from the shipping boxes and wet the roots thoroughly. Then cut the strings and place the trees upright in a thin layer against the vertical side of the trench. A bunch of trees should be spread over about six inches in the trench. Fine soil should be placed against the roots and lower part of the stems, and firmed with the foot.

Trees should be "heeled-in" if they cannot be planted the day they are received.

Fourteen additional forest tree nurseries were started in 1921 and 1922 at State institutions. The seedlings grown in those nurseries will be distributed free by the Pennsylvania Department of Forestry.

THE PLANTING OPERATION

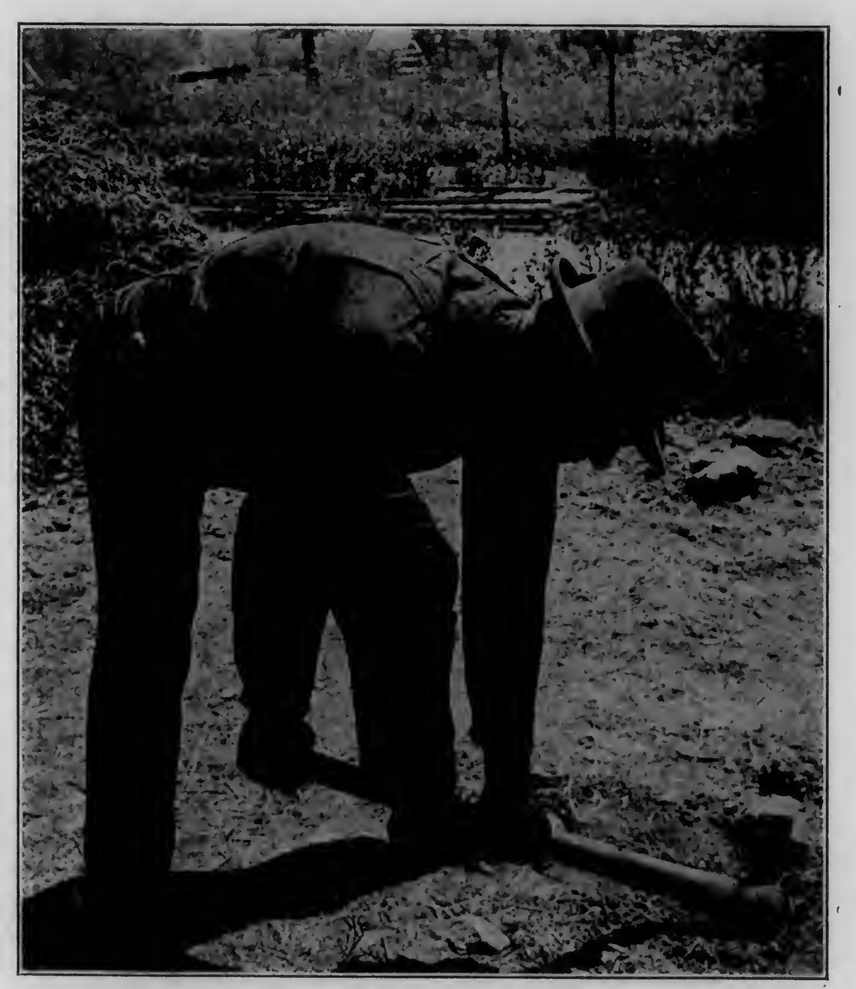
THE roots must be kept moist at all times. If they are allowed to dry out the tree may die. Two persons make a good planting crew, a mattock man to dig the holes and a planter to set the trees. Dig the holes in rows. The distance between rows, and also the distance between trees in each row, is usually five to six feet. The spacing will depend upon the kind of trees used, the quality of soil, and on what is now growing on the area.

Where the ground is not stony nor the sod heavy, one stroke with the mattock will usually make a hole large enough to plant a 2-year-old seedling. The hole should be big enough to let the roots spread. Loose dirt is carefully drawn to the edge of the hole where it can be easily reached by the planter. If the sod is heavy at least one square foot should be turned back with the mattock, and a hole made in the loose earth.

The planter with a supply of trees in a pail follows the mattock man. The pail should contain about an inch of water to keep the roots moist. Holding a tree in his left hand the planter sets it in the hole as deep as it was in the nursery, as shown by the "collar" on the seedling. The roots should be spread out and loose earth pressed over and around them with the right hand. The remaining loose dirt is then drawn into the hole and packed firmly with a mallet, a stone, or the heel of the shoe. No grass, leaves, or stones should come in contact with the roots. When properly planted the seedling will stand upright and be so firm that it cannot easily be pulled up.

An annual demand for 20,000,000 forest trees and for 15,000 shade and ornamental trees is expected by the Department of Forestry officials by 1925.

Two persons make a planting crew, a mattock man to dig the holes and a planter to set the trees. Carry the trees in a bucket so that the roots may be kept moist at all times.



One stroke with the mattock will make a hole large enough to plant a tree. If the sod is heavy one square foot should be turned back with the mattock and a hole made in loose dirt.

Loose dirt, carefully drawn to the edge of the hole, can be easily reached by the planter.

With his left hand, the planter sets the tree in a hole as deep as it was in the nursery. The roots should be spread out and loose earth pressed around them.

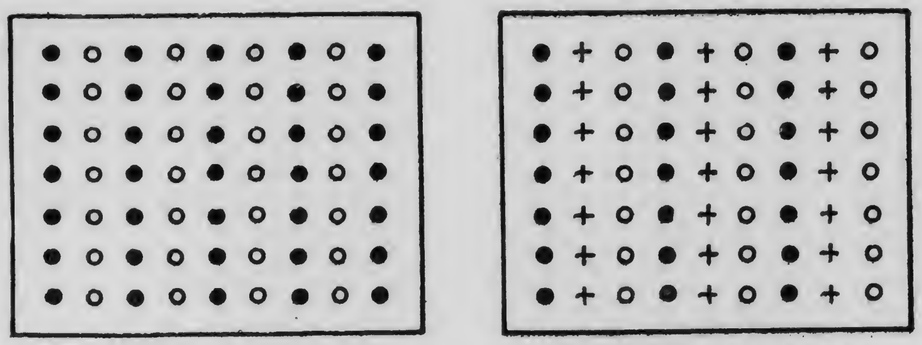
Loose dirt is packed firmly around the roots with the heel of the shoe.

A stone is very effective in packing the dirt tightly around the roots.

When properly planted the seedling will stand upright and be so firm that it cannot easily be pulled up.

PROTECTIVE MEASURES

AS a rule each destructive insect or disease attacks trees of one species only. Nearby trees of other species may not be affected. The chestnut blight attacks only the chestnut, the white pine weevil attacks chiefly the white pine and the locust borer works wholly in the black locust. To guard against loss from insect attacks or diseases, areas larger than an acre should be planted with a mixture of two or more kinds of trees that have the same needs for soil and light and the same rate of growth. This can most easily be done by alternate rows, as shown in illustration below:



Using two species Using three species

ALTERNATING BY ROWS.

When white pine is planted all cultivated or wild currant and gooseberry bushes growing within 900 feet should be destroyed. The best way is to pull them up by the roots and hang the plants on nearby trees or brush so that they cannot take root again. This is to guard against the Blister Rust, a fungus disease that kills white pines. The Blister Rust cannot spread from pine to pine but must spend a part of its life on the under side of current and gooseberry leaves, from which spores spread to the pines and cause the rust.

Live stock will eat the leaves and tender twigs of hardwood seedlings and root up, break and tramp down small evergreens. No plantation can succeed when animals are allowed to graze over or root up the planted site.

Livestock will eat the leaves and tender twigs of hardwood seedlings and root up, break, and tramp down small evergreens.

PROTECTION AGAINST FIRE

FOREST fires have devastated more than one-third of the forest area of Pennsylvania. Even a very light burning will kill small trees. Hence, fires must be kept out. On a farm this danger is usually slight, and little need be done except, possibly, the posting of a few forest fire notices. When a plantation is made near large wooded areas where fires are likely to occur, or if the plantation is large and destruction would involve heavy loss, special precautions should be taken. In addition to posting fire warnings, this can best be done by cutting fire lines or by putting on a patrol during dry seasons.

During the last thirteen years, private planters have received from the Pennsylvania Department of Forestry 18,250,000 young forest trees which were set out in all parts of the State.

GROWTH TO BE EXPECTED

THE following tabulation gives a summary of the number of years that will be required to mature some of our most important forest trees on sites best adapted to each of them. The most common uses of the wood produced by these trees are also listed:

Kind	Where To Plant	Years To Mature On Best Sites	Uses of Wood
Carolina poplar	Moist fertile soil	25	Pulp, crates.
Black locust	Dry sterile soil to fertile loam	30	Posts, ties, insulator pins.
White ash	Rich moist soil	50	Implements, furniture, handles.
Red oak	Loam to sand or gravely soil	75	Furniture, interior finishing, ties.
Black walnut	Rich, moist bottom lands	60	Furniture, gun stocks, veneer.
Sugar maple	Deep fertile soil to rocky hills	75	Furniture, interior finishing (maple sugar).
Larch (European or Japanese)	Well-drained medium fertile soil	40	Poles, posts, ties, mine timbers.
Pitch pine	Medium fertile soil to dry slopes	60	Construction timber, mine props, ties.
White pine	Fertile well-drained soil to gravely hillsides	50	Lumber, wooden ware, excelsior.
Red pine	Deep loam to dry sand and gravel	60	Construction timber and lumber.
Norway spruce	Deep moist to thin cold soils (will not thrive in wet locations).	75	Construction lumber, pulp, thinning for Christmas trees in 8 years.

PLANTING STOCK

TREES for reforestation are distributed by the Pennsylvania Department of Forestry under the following conditions:

1. They must be planted in Pennsylvania.
2. They must be planted by the applicant or his representative, and may not be offered for sale or be sold.
3. They should be set out in accordance with the best and most practical modern methods.
4. The planted trees must be protected, as far as possible, from fire, grazing, trespass, and other destructive agents.
5. Fewer than 100 trees cannot be furnished to one applicant.

In the spring of 1922, the Pennsylvania Department of Forestry gave without cost 3,500,000 trees to 1,200 private planters in this State.

HOW TROUBLE TROUBLED LITTLE BEAR FOREST

A STORY FOR SCHOOL CHILDREN
THAT WILL ALSO
INTEREST THE GROWN-UPS

BY

NORAH APPLE STADDEN
Special Forest Fire Warden

BULLETIN 29

PENNSYLVANIA DEPARTMENT OF FORESTRY
ROBERT Y. STUART, Commissioner

1922

PENNSYLVANIA DEPARTMENT OF FORESTRY

STATE FOREST COMMISSION

Robert Y. Stuart, Commissioner of Forestry.
Edward Bailey.
Henry W. Shoemaker.
Mrs. John W. Lawrence.
(Mary Flynn Lawrence.)
Henry S. Drinker.

Alfred E. Rupp, Chief, Bureau of Lands.
Lewis E. Staley, Chief, Bureau of Operation.
George H. Wirt, Chief, Bureau of Protection.
John W. Keller, Chief, Bureau of Silviculture.
W. E. Montgomery, Chief, Office of Maintenance.
A. O. Vorse, Chief, Office of Information.
Joseph S. Illick, Chief, Office of Research.
E. A. Ziegler, Director, State Forest Academy.

HOW TROUBLE TROUBLED THE LITTLE BEAR FOREST.

Monday morning and school! Restless springtime! April joyousness! And yet all the pupils of the Jenkens Grammar School walked to the school building that morning wrapped in deepest gloom.

Little groups were gathered here and there on the play ground. The older boys, all Boy Scouts, were discussing the matter quietly; but the younger boys, who belonged to the Junior Campers' Club, were more noisy.

"I guess my dad is the policeman and he'll just put the fellow in jail that did it." "Oh, you make me sick! A cop can't put any one in jail. He just arrests people, but my uncle is the judge and I guess he'll fix him." "Just think, all this trouble from one little match," was the remark that came from one of the Camp Fire Girls standing on the steps by the door.

The primer class was all huddled down by the gate. They didn't know how to talk it over, their little minds just knew there wouldn't be any more picnics out by the lake and Miss Jessup couldn't

sit with them under a big shady tree and tell them about Cinderella and Jack and the Bean Stalk, because there weren't any more trees.

Little Betty Evans choked on sobs when she tried to say something about her "booful bird," and all they could do was to wait for their beloved Miss Jessup to come and comfort them. When they saw her, Betty darted for the arms that stooped to gather them all close.

"Oh, Miss Jessup do you think,—do you think my booful bird is all burned up dead?" her voice a wail of anguish at the thought.

"I'll bet it burned up all the rattle snakes, darn 'em." "Oh, Danny!" A reproachful tone chided him, "have'nt I told you little gentlemen don't say words like that, and certainly not when girls are around?" "Well, I'll bet it did anyhow," and two chubby fists went into pockets and Danny defiantly shoved the toe of one shoe into the dirt.

"No Betty honey, the bird isn't dead, it could fly away you know. Of course its nice nest is burned up, but then you remember that nest was its last year's house, so it might want to make a new one this year." "How can it make a new one, Miss Jessup, if the tree is burned up?" "Why it will have to hunt another place with more trees, just as we shall have to do, baby. Come children there's the bell." The doors opened and every pupil hurried to

his own classroom, eager to discuss the situation with the teacher. "Mr. Davis, wouldn't you think people would be careful with fire if they wanted to fish?" "Mr. Davis"— "Oh, let me talk," broke in an insistant voice, "why say, can't people read? It says all around: 'Mr. Fisherman, be a good friend, a good neighbor, and a good sportsman, be careful with your fire. Somebody's carelessness causes fire.' Why, I read it myself. And then"——.

"The class will please come to order for the morning session; we will talk about the forest fire at recess." So the class tried to settle down to daily routine work.

The little town of Jenkens was proud that it belonged to northeastern Pennsylvania, the Pocono region that is famous throughout the East for its beauty. High mountain ranges that give it a scenic dignity; clear mirror-like lakes that make one long for vacation and play time; winding rivers whose banks once knew the Indian's wigwam; fields of grain waving in the broad valleys; all this calls in summer to the tourist and to those who love the stillness of the woods.

The Little Bear Forest lay about ten miles from the village, giving every one for miles around an opportunity to hunt, fish, and camp within its boundaries. This Forest was only one of many scattered throughout Pennsylvania, owned by the

State and operated and administered by the Pennsylvania Department of Forestry.

The Boy Scouts had found the State Forest an ideal place for their annual camping trips. They pitched their tents on the bank of the Little Bear Lake and swam and fished, and in the long evenings told stories round a big fire camp.

Then the younger boys organized a Junior Campers' Club and under the careful supervision of one of the Scout Masters they, too, spent a week every summer in the open along the lake.

The Camp Fire Girls sometimes camped there for days at a time, or sometimes they hiked the ten miles, spent the night, and walked home the next day.

Even the kindergarten children spent a day now and then during the summer, going along with Miss Jessup and carrying a couple of well-filled baskets. After their picnic lunch they all sat under the trees and listened to the stories Miss Jessup told them. And always when she would end up with, "And now it is getting late, children, we must get ready to start," there would come an eager clamoring for "just one more story, Miss Jessup. Tell us about the Little Bear." So she would tell them the old Indian legend about the little bear that the Indians used to see so often around the shores of the lake just about dusk until they grew to believe it was

the spirit of the lake; and so they called this the "Little Bear Lake."

During the past summer little Betty had been keenly interested in a bird whose nest she had found. The child loved birds, she listened intently to everything she could hear about them and took particular interest in this especial one.

All the children who attended the Jenkens school were being taught a deep love for the woods, and it remained for Franklin Barclay, Forester in charge of the State Forest, to teach them what the forests really mean to Pennsylvania, and what fearful destruction follows in the path of a carelessly thrown match or a forgotten campfire.

To Forester Barclay his hardest task lay in trying to keep fire out of the Forest during the two danger periods of the year, known as the spring and fall seasons. In the early spring, after the snow has gone and before the trees are green, there comes a long dry two months, during which time fire is so easily started through the thoughtlessness of the fishermen who enjoy the privileges of the forest.

The same condition prevails in the fall, for when the trees have lost the radiant glory of their autumn leaves they spread a carpet that is as inflammable as it is beautiful.

The Forester had watched with pleasure the enthusiasm and interest with which these boys and

girls enjoyed their days spent in the woods, and realizing that they would be the sportsmen of the future he decided to teach them all he could about the prevention of fire.

Accordingly he made it a point to spend a few hours, sometimes a day, with them when they camped in the State Forest. He taught them not to smoke while walking through the woods, and better still not to smoke at any time; to keep their matches in tin boxes, not only to preserve them from dampness but to prevent losing them in the woods; he taught them how to build camp fires and how to put them out, in fact, to be sure they were out before they left their camps.

Taking them through a forest plantation he explained the process of reforestation by means of which Pennsylvania may hope in time to be able to produce again her own lumber. Two of the white pine plantations were especially interesting. They were about ten years old and stood nearly a quarter of a mile back from the lake. The young pine trees, growing straight and sturdy in their even rows looked like rugged pioneers of a new and sacred cause.

How pretty everything had been that early April Saturday morning! Blue sky pictured in the lake's clear water, warm sunshine trying to coax the shy wild flowers into bloom, and the air filled with the

woodsy leaf mold odor that makes one realize spring is waking the earth again.

Forester Barclay, at work in his office on weekly reports, stopped to answer the telephone. Some one was reporting smoke seen over in the direction of Laurel Creek, and hurriedly climbing a nearby tower he saw a fire burning. Devoutly hoping that prompt action might prevent a serious fire he sent out calls for men. But in spite of the immediate response of men from the whole vicinity, the fire, fanned steadily by a breeze that sprang up, burned on swiftly and relentlessly.

All day and almost all night the Forester, Fire Wardens, and men matched their strength against the hissing, seething monster that raced by them until it finally lay quenched in the waters of the lake.

And when Sunday dawned the sun shone on trees that would never bud and leaf again, on miles of black gaunt skeletons, on burned pine plantations that lifted dead arms to Heaven, a mute proof of the carelessness of man.

And so all that Monday morning not a child in the school could think of anything but the fire. Mr. Davis had sent his class in arithmetic to the board and stood watching his brightest pupil hesitate over the solution of a simple problem.

"Benton, didn't you go over the day's work?" he asked. "Yes sir, some of it." "Don't you understand the problem?" "Yes sir." "Well! What's the matter?"

"Mr. Davis I was wondering if it wouldn't be a good idea to have patrolmen scattered over the State Forests during fire season who could follow up campers and see that camp fires were put out."

"Yes, maybe it would," flashed back an answer from one of the other boys, "but where are they going to get the money to pay all those patrolmen? Mr. Barclay told me only the other day that the forest protection work would be much easier and more efficient if they had the money that was needed for the work. I bet I'll never vote for any man who isn't going to work for a big forestry appropriation."

Mr. Davis put his book down with a gesture of despair and to his relief the bell sounded for recess.

As soon as the students were dismissed he called a faculty meeting and each teacher reported the same lack of attention on the part of the pupils.

"What do you think about asking Mr. Barclay to come out this afternoon and talk to the children," volunteered Miss Merton. Her class in fractions had been a great trial to her that morning because they repeatedly wished to know where they were going to camp hereafter if one-half the State Forest on one side of the lake was burned over.

"I think it a good suggestion if he can come," and Mr. Davis called the Forester's headquarters and explained the situation.

Yes, Mr. Barclay could come and would be at the school as soon as he could make arrangements to leave his Forest in charge of his ranger for an hour or two.

In the meantime the pupils returned from recess and were given a study period until the Forester arrived, when they all marched into the Assembly Hall.

A tired and discouraged man faced them, but he carried a message they were waiting to hear.

"Boys and girls, I know how badly you feel about the fire that occurred last Saturday; you feel particularly bitter about it because it is your picnic and camping ground that has been so ruthlessly destroyed. A place you knew and loved, where you spent a great many happy vacation days is charred and desolate. The plantations we watched with so much interest are dead. The patient work of years was wiped out in a few hours. Surely this shows you that forestry is a work that does not belong alone to the Commissioner in Harrisburg, to the men in the office, nor to the men in the field.

"In Harrisburg are men who are there to lead and direct while we men in the field are here to serve. But we must all have behind us the faith,

the enthusiasm, and the co-operation of every man, woman, and child in the State. Lacking that we can never succeed in the work we have chosen.

"But in the face of discouragement, opposition and lack of money the Department of Forestry is going to work on until every citizen is taught to see the vision of the future Pennsylvania reforested and again producing her own lumber. Once that is accomplished every person will lend himself to the work of forest protection, because he will understand the value of our woodland.

"I know you boys and girls are eager and glad to help whenever you can. You know that in every township in this county, as in every county in the State, there is at least one man who serves as Fire Warden. All fires occurring in his township are reported to him and he sees that they are put out. If any of you should see a fire or hear of a fire, your first duty would be to notify me, and if that is not possible try to notify the Fire Warden in whose township the fire is burning. You can always find a list of the Fire Wardens in the telephone directory. If you have no directory the telephone operator can tell you whom you should call, or you can report the fire to some older person who will notify the right Fire Warden. And always remember to be careful with matches when walking through the woods or anywhere that fire will burn.

"We hope that we have had our last fire this season and that all persons using the State Forest from now on will be very careful.

"In a few weeks you will be hunting new locations for your camps; and from the interest you have shown, the careful attention you have given my instructions and as a result of this experience I know you will not be careless campers. And now before we leave this hall let us rise and repeat the pledge we took some time ago."

At the signal the children rose, and from the dozens of throats came the strong response, "we pledge our allegiance to our country; to her flag and all it stands for; to her forests and their future."

IRREGULAR PAGINATION

The Forest Situation

IN

Pennsylvania

BY

JOSEPH S. ILLICK
Chief, Office of Research

BULLETIN 30

PENNSYLVANIA DEPARTMENT OF FORESTRY
ROBERT Y. STUART, Commissioner
January, 1923

PENNSYLVANIA DEPARTMENT OF FORESTRY

STATE FOREST COMMISSION

R. Y. Stuart, Commissioner of Forestry.

Edward Bailey.

Henry W. Shoemaker.

Mrs. John L. Lawrence.
(Mary Flinn Lawrence.)

Henry S. Drinker.

Lewis E. Staley, Chief, Bureau of Operation.

George H. Wirt, Chief, Bureau of Protection.

John W. Keller, Chief, Bureau of Silviculture.

Alfred E. Rupp, Chief, Bureau of Lands.

Joseph S. Illick, Chief, Office of Research.

W. Erdman Montgomery, Chief, Office of Maintenance.

A. O. Vorse, Chief, Office of Information.

E. A. Ziegler, Director, State Forest Academy.

THE FOREST SITUATION IN PENNSYLVANIA.

The forests have, in all ages and in all countries, for a time at least, been squandered by man with a careless disregard of the future, Pennsylvania— the only State in the Union that embodies the word "forest" in her name—is no exception, for her forests have been wastefully exploited, and, until recently, no effective measures for their renewal have been put into practice.

The first settlers of Pennsylvania lived among a rich forest heritage which made possible much of the prosperity of the past and resulted in good that is still flowing forth to all of us. Great and green forests once covered every hill and all the valleys of the State. The original forest was an enormous wood reservoir. It has been drawn upon so heavily and neglected so long that it is now almost empty and in a very unsatisfactory condition. This great forest heritage was received at little or no cost. People began to use it unsparingly and gave little or no conscious care to its perpetuation. Where once stood fine stands of choice timber there now remain vast stretches of devastated forest land.

In 1860 Pennsylvania stood first among the states of the Union in lumber production. Now she holds eighteenth place. She has passed from a position of leadership to a place of dependency in the field of lumber production. Once the State was forest-rich. Now we are forest poor. Our present forests are poorly stocked with inferior material. They are producing through growth only about one tenth of the wood they are capable of turning out. Most of them lack order, are unattractive and in an insanitary condition.

Civilization cannot progress without forest products. We need wood now and future generations will not be able to get along without it. Nothing comes out of the earth or grows upon its surface that is more adaptable to man's needs than wood. It is our duty to take steps toward upbuilding Penn's Woods. We cannot afford to be visited by a serious wood shortage. Our barren hill sides must be converted into growing forests. The application of simple and sound forestry methods will bring about the required improvements. An orderly management of our forests will make them highly productive, attractive, and sanitary.

The data set forth in this bulletin shows the real forest situation of the State. They aim to tell (1) what we once had, (2) what now remains, and (3) what is needed in order to supply our people with necessary forest products.

FOREST AREA OF PENNSYLVANIA.

The original forests of Pennsylvania covered the entire land surface of the State, excepting a few natural meadows and some rough mountain tops. Of the 28,692,480 acres of land in the State at least 28,650,000 acres were originally stocked with a forest growth; and in 1682, when the State was created there remained about 28,592,000 acres of forest land.

The following table gives, by years the approximate area of forest land in the State:

FOREST AREA OF PENNSYLVANIA.

YEAR	ACRES
1600	28,650,000
1682	28,592,000
1820	24,500,000
1860	18,800,000
1922	13,024,399

The foregoing table shows that the marsh of forest destruction in Pennsylvania was rapid. In the early days most of the cut-over land was cleared. This was particularly true prior to 1860. Most of the large lumbering operations between 1860 and 1900 were conducted in the mountainous parts of the State, and during this period only a small percentage of the lumbered areas was cleared for agricultural purposes; and of the land that was cleared a large percentage has since been abandoned and is slowly being restocked naturally with a growth of forest trees.

The forest area of Pennsylvania reached its minimum about 1900, when there were approximately 12,000,000 acres of forest land in the State. From 1900 to 1922 a large acreage of farmland was abandoned, for it was found that most of the cleared mountain land was not suitable for agricultural purposes. This abandoned farmland is being restocked naturally with trees and the total forest area of the State is now (1922) 13,024,399 acres.

On the basis of present indicating factors it seems conservative to estimate that there will be approximately 14,000,000 acres of forest land in Pennsylvania 50 years from now (1972).

AMOUNT OF WOOD IN FORESTS OF PENNSYLVANIA.

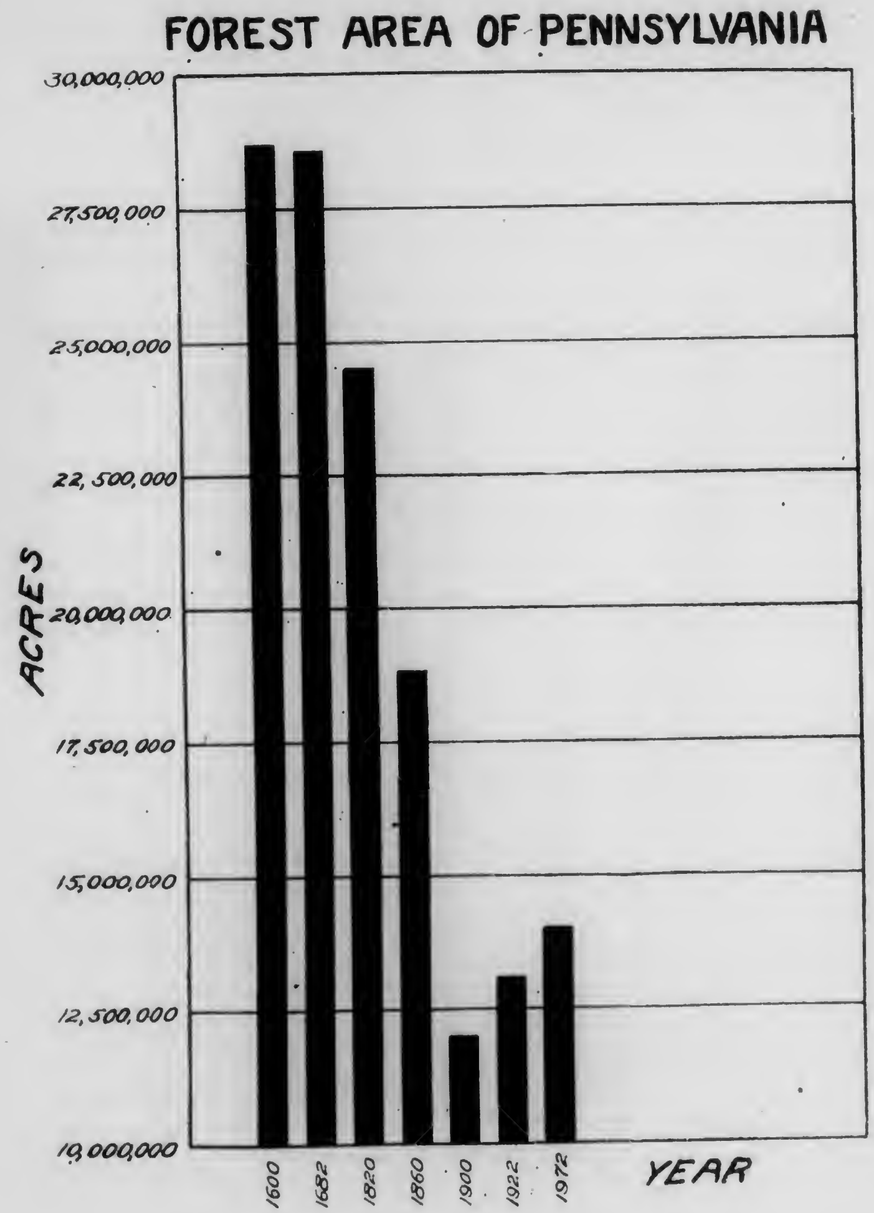
The original forests of Pennsylvania were not only vast in extent, but were made up of important timber trees that produced large quantities of valuable wood. The wood that flowed forth from them in enormous quantities was of a superior quality. The following table gives an estimate of the quantity of wood in the forests at specified years in the State's development:

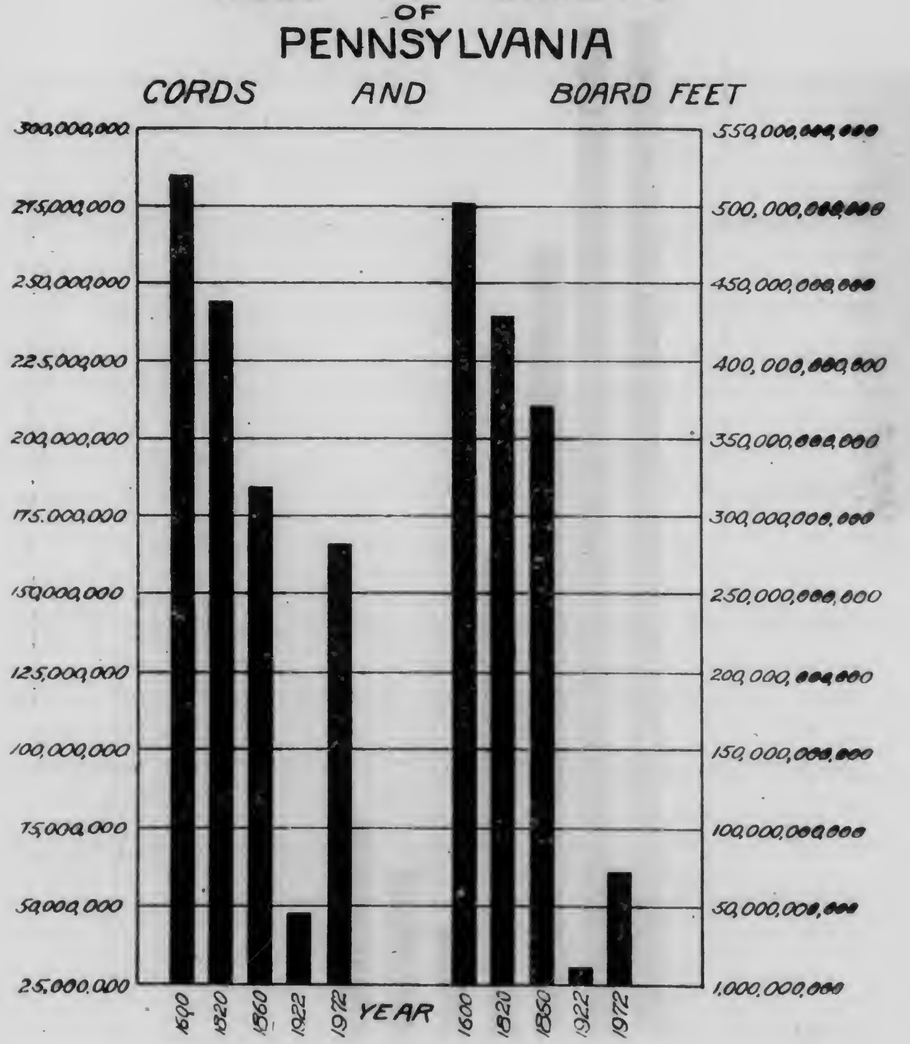
WOOD IN FORESTS OF PENNSYLVANIA

YEAR	VOLUME Board Feet	Cords
1600	501,375,000,000	286,500,000
1820	428,750,000,000	245,000,000
1860	370,000,000,000	186,200,000
1922	11,676,211,200	48,650,881

The average acre carried approximately 17,500 board feet of lumber and 10 cords of wood. On the basis of this estimate there were 501,375,000,000 board feet of lumber and 286,500,000 cords of wood on the 28,650,000 acres of forest land in the State when the white man set foot on her soil.

By 1820 the forest area was reduced to 24,500,000 acres. The average acre carried 17,500 board feet of lumber and 10 cords of wood.





On the basis of this estimate there were 428,750,000,000 board feet of lumber and 245,000,000 cords of wood in the forests of Pennsylvania in 1820.

By 1860 the area of forest was reduced to 18,500,000 acres of original forest and 300,000 acres of completely cutover and second growth forest land, making a total of 18,800,000 acres. The average acre of original forest carried 20,000 board feet* of lumber and 10 cords of wood; and the cut-over and second growth forest land was stocked with an average of approximately four cords of wood. On the basis of this estimate there were 370,000,000,000 board feet of lumber and 186,200,000 cords of wood in the forests of Pennsylvania in 1860.

The forest area of Pennsylvania was reduced rapidly, and now (1922) 13,024,399 acres remain, of which only approximately 25,000 acres can be classified as original forest. The amount of wood on all of this forest land of the State is estimated at 81,084,801 cords. This represents an average of six and one-fourth cords per acre.

Of the total amount of wood—81,084,801 cords—approximately 60% is of cordwood size and 40% may be converted into lumber. On the basis of this estimate there are at present (1922) 48,650,881 cords of wood and 11,676,211,200 board feet of lumber in the forests of Pennsylvania, that is, approximately three and three-fourths cords of wood and 896 board feet of lumber on the average acre. Cords are converted into board feet by using 80 cubic feet per cord and 4.5 board feet per cubic foot as converting factors.

The area of forest land in Pennsylvania in 1922 and the wood present thereon is given in the following table, which divides the forest land into (1) farm woodlots; (2) State Forests; and (3) forest land outside of farm woodlots and State Forests:

	Area (Acres)	Volume On Average Acre (Cords)	Total Volume (Cords)
Farm Woodlots, ...	4,043,902	12.0	48,526,824
State Forests, ...	1,126,237	4.5	5,068,067
Outside of Farm Woodlots and State Forests.	7,854,260	3.5	27,489,910
	13,024,399	6.2	81,084,801

It is also estimated that by 1972 the forest area of Pennsylvania will have increased to approximately 14,000,000 acres and that the amount of wood on the average acre should be about 26.5 cords. This gives a total wood volume of 371,000,000 cords in the forests of the State, of which about 45% will be cordwood and 55% workwood (lumber). On the basis of this estimate there will be in the forests of Pennsylvania 73,458,000,000 board feet of lumber and 166,950,000 cords of wood. This estimate gives 5,247 board feet and 11.9 cords as the amount of wood on the average acre of forest land in the State in 1972.

*The average acre of original forest left in 1860 contained more board feet than the average acre in 1600 and 1820, for most of the hardwood forest, which was stocked relatively light, had been cut-over and most of the heavily stocked white pine and hemlock stands still remained.

The estimated increase in the wood volume on the average acre of forest land in Pennsylvania during the next 50 years is given by decades in the following table:

Year	Amount Of Wood On Average Acre (Cords)
1922	6.2
1932	8.5
1942	12.5
1952	17.8
1962	23.0
1972	26.5

The above table shows that during the next fifty years the amount of wood on the average acre will increase from 6.2 cords to 26.5 cords—an increase of 20.3 cords on the average acre.

PRESENT VALUE (1922) OF PENNSYLVANIA'S FORESTS.

	Area (Acres)	Average Value Per Acre	Total Value
State Forests (January 1, 1922), ...	1,126,237	$10.88	$12,255,439.51
Farm Woodlots, ...	4,043,902	21.00	84,921,942.00
Other than State Forest and Farm Woodlots,	7,854,260	4.75	37,307,735.00
	13,024,399	$10.33	$134,485,116.51

This estimate of value is based upon an approximate land value of $2.00 per acre, $7.00 per thousand for lumber, and $0.50 per cord for fuel wood.

During the next fifty years the forests will not only increase in wood volume but also in equality and value. There will be a marked improvement in forest composition and forest conditions, and a big increase in forest values. An estimate of the value of the future forests of Pennsylvania follows:

ESTIMATED VALUE OF PENNSYLVANIA'S FORESTS (1972)

LAND VALUE	
14,000,000 acres @ 8.00, ...	$ 112,000,000
WOOD VALUE	
a. 73,458,000,000 board feet @ $20.00 per M., ...	1,469,160,000
b. 166,950,000 cords @ $2.00 per cord, ...	333,900,000
	$1,915,060,000

On the basis of the above estimate the value of the average acre of forest will be approximately $137.00 in 1972.

In making estimates of forest values, it is important to consider the determinating factors that affect value. Unstocked or poorly stocked forest soil is valued at the local sale of unproductive forest soil. The introduction of forestry methods and practices transform unproductive into productive soil. The forest soil is changed from a passive to an active commodity. It is made revenue producing. By way of example, let us assume that a business enterprise sells stock at par, $100.00 per share, and pays 8% dividends. Business improves and the concern's output is enlarged. Financial conditions permit the company to raise the dividends to 12%. As a result, the stock sells for $150.00 per share. Capital value has been created by the increased earning capacity. The same increase in value occurs when barren—unproductive—forest land is made to produce a larger quantity and a better quality of forest products for which a constantly increasing demand exists.

LUMBER PRODUCTION AND CONSUMPTION IN PENNSYLVANIA.

In 1860 Pennsylvania stood first among the States of the Union in lumber production. Then she produced much more lumber than her people needed. She held a prominent place in the field of lumbering until about 1890 when she suddenly changed from a lumber exporting to lumber importing state. To-day more than 84% of the lumber and 74% of the pulp wood used in the State comes from without her borders. The following table shows the relation between lumber production and lumber consumption in Pennsylvania:

Year	Lumber Consumption (Board Feet)	Lumber Production (Board Feet)
1880	1,567,538,000	1,733,844,000
1890	1,992,787,000	2,113,267,000
1900	2,791,837,000	2,231,284,000
1910	3,242,342,000	1,241,199,000
1918	2,632,965,000	530,000,000
1919	2,694,526,350	630,471,000
1921	2,719,200,000	510,000,000*

* Estimated.

The per capita lumber production is a better indicator of the actual forest siuation than the total lumber production, for with the rapid decrease in lumber output, due to forest depletion, there has been a continuous increase of population. The per capita production of lumber in Pennsylvania during the past thirty years is shown in the following table:

Year	Total Lumber Production (Board Feet)	Per Capita Lumber Production (Board Feet)
1890	2,113,267,000	420
1900	2,321,284,000	387
1910	1,241,199,000	162
1918	530,000,000	63
1921	510.000,000	58

The low stage of lumber output in Pennsylvania has not yet been reached, but will come in about five years from now when virtually

every acre of mature timber, excepting small scattered stands, will have been cut over. Then and thereafter, until the effects of adequate forest protection and good forest treatment make themselves felt in an increased forest, output, the painful effects of a timber shortage will be keenly felt.

The foregoing tables show that the people of Pennsylvania consume annually 309 board feet of lumber per capita, while the production of lumber is only 58 board feet. This indicates that our forests at the present time are supplying only 16% of the total lumber needs of our people. The present total cut of lumber in Pennsylvania is less than the amount consumed in the Pittsburgh district alone. The right way to rectify the present unbalanced relation between wood consumption and wood production in Pennsylvania is not to reduce consumption but to increase production The reduction of wood consumption will work unnecessary hardships on industries and deprive homes of essential comforts, while an increase of wood production can be accomplished without a hardship or a big sacrifice on the part of anyone.

We cannot hope to get much relief for the wood situation from nearby states, for Pennsylvania is almost completely surrounded by wood-importing states. West Virginia is the only bordering wood-exporting state. The only nearby wood-exporting states are West Virginia, Virginia, North Carolina, and South Carolina. These four states are rapidly approaching the wood-importing stage. Their lumber surplus at present almost equals the lumber shortage in Pennsylvania. The annual surplus of these states is rapidly decreasing, and consequently the wood situation is serious, for in a few years the Pennsylvania deficit must be made up from more remote sources of supply. Our wood needs will continue to grow. Each year greater difficulty will be experienced in satisfying them. It is therefore, imperative that special efforts be put forth to increase the output of our forests. We have plenty of forest land. All that is necessary is to put the land to work and, in time, it will produce most of the forest products needed to meet our requirements.

GROWTH, YIELD, AND INCOME OF PENNSYLVANIA FORESTS

The growth of the forests of Pennsylvania is extremely subnormal. They are now producing only about one-tenth of the wood they can be made to turn out. If the forests are given proper protection and handled carefully, their growth will gradually increase, for forest land responds promptly to any conscious care that is given to it. The estimated annual growth per acre during the next fifty years is given in the following table by decades:

Decade	Average Annual Growth Per Acre (Cords)	Growth Per Acre During Decade (Cords)
1922—1932	0.25	2.5
1932—1942	0.50	5.0
1942—1952	0.75	7.5
1952—1962	0.90	9.0
1962—1972	1.00	10.0
	Total, ...	34.0 cords

Under proper care and treatment, the forest land of Pennsylvania will produce at least one cord per acre per year. This estimate is fully supported by numerous measurements of the growth of forest stands in Pennsylvania and within similar forest types in New England.

A yield of a cord per acre per year was secured on second cuttings of mixed hardwood stands on the Michaux and Mont Alto State Forests when charcoal furnaces were in operation. Recent growth studies show that middle-aged white oak stands in Huntingdon County are growing at the rate of 1.2 cords per acre per year. Dr. R. T. Fisher, Director of the Harvard Forest School, states that "it is safe to count on 35,000 board feet of saw timber to the acre at a rotation of 60 years in mixed pine (85%) and hardwoods". Prof. J. W. Toumey ("Seeding and Planting") writes that "a white pine plantation near Keene, N. H., planted in 1871, and measured in 1915, contained approximately 30,000 board feet of wood per acre". Near South Lancaster, Mass., is a plantation of white pine that is laying on wood at a rate of more than 1,000 board feet per acre per year. Another Massachusetts white pine plantation at the age of 60 years contained 400 trees to the acre, and yielded 41,000 board feet per acre. A 46-year old plantation of white pine located near West Monponsett, Mass., was cut a few years ago and yielded 30,000 board feet per acre. The site was an old farm abandoned shortly after the Civil War. The only care ever given to the tract was the removal of dead trees. Had the trees been spaced closer than 10 x 10 feet and been given better care, they would have grown taller and yielded more and better timber.

The Pennsylvania Department of Forestry estimate of forest growth—one cord per acre per year—is conservative compared with the growth of well-managed European forests upon which growth conditions are in many cases less favorable than in Pennsylvania. For example, a 60-year old plantation of American white pine in Germany is growing at the rate of 135.5 cubic feet (1-½ cords) per acre per year. The communal forests of Boveressee, Switzerland. produced 138 cubic feet per acre in 1892 and 146 cubic feet (almost 1-⅔ cords) in 1916. The average annual timber growth in Saxony is 93 cubic feet (more than one cord) per acre. The annual timber growth in the Sihlwald, Switzerland, is 124.6 cubic feet (more than 1-⅓ cords) per acre.

A plantation of Douglas fir, native to western North America. made a growth of 159 cubic feet per acre per year; another plantation made a mean annual growth of 274 cubic feet (3 cords) per year.

With a probable future forest yield in Pennsylvania of one cord (90 cubic feet) per acre per year, the average annual production in board feet and cords per acre at specified ages will be:

Age (Years)	Forest Yield Per Acre
50	270 board feet and ½ cord of wood.
75	350 board feet and ⅓ cord of wood.
100	405 board feet and ¼ cord of wood.

When the annual yield of one cord per acre is reached by 1972, then the forests of Pennsylvania will be yielding annually 14,000,000 cords of wood, or its equivalent, if other units of wood measure are used. It is ulta-conservative to predict that they will yield annually 10,000,00 cords of which 55% will be workwood (timber) and 45% fuel wood. This means that the forests of Pennsylvania, by 1972, will yield annually at least 2,400,000,000 board feet of lumber and 4,500,000 cords of wood. This estimated yield of lumber is greater than the largest annual output (2,321,284,000 board feet in 1900) of lumber in Pennsylvania during the big lumbering days.

What the income of the forests of Pennsylvania will be in fifty years from now is difficult to predict. Many variable factors influence the price of forest products. Stumpage prices have increased remarkably during the past thirty years, particularly during the past five years. The prices of some wood has increased 400%, and a few kinds of wood have increased as much as 500% in fifteen years. From the experience of foreign countries and the trend of prices of forest products and forest land values, it is absolutely safe to predict that in fifty years the net income from the forests of Pennsylvania will average at least $2.50 per acre per year, and it may reach $4.00. When restored to full production, the well-managed forests of the State will yield a net annual return of $6.00 to $7.00 per acre. This prediction is supported by financial data of the principal state forests and selected municipal forests of Europe. The gross and net income derived from these forests is shown in the following table:

INCOME PER ACRE FROM STATE FORESTS OF GERMANY.

	WURTTEMBERG (400,000 acres)		SAXONY (431,000 acres)		BAVARIA (2,320,000 acres)		PRUSSIA (6,796,000 acres)	
Years	Gross	Net	Gross	Net	Gro s	Net	Gross	Net
1830		$ 82		$1 10		$ 46		$ 44
1850-59	3 60	2 11	3 03	1 91			91	54
1860-69	4 73	2 89	4 46	3 21	2 32	1 35	1 43	88
1870-79	5 77	3 45	5 76	3 92	2 95	1 66	1 96	97
1880-89	4 99	2 70	6 47	4 33	2 64	1 30	2 20	1 01
1890-99	6 35	3 87	7 13	4 50	3 73	1 81	2 68	1 29
1905	9 20	6 10	8 44	5 39	4 55	2 00	4 26	2 42
1906	10 05	6 78	8 28	5 08	4 95	2 55	4 27	2 27
1907	10 90	7 47	9 60	6 17	4 90	2 55	4 54	2 51
1908	10 00	6 50	9 22	5 58	5 50	2 95	4 45	2 21
1909	9 90	6 35	8 96	5 24	6 30	3 30	4 53	2 02
1910			9 15	5 36			4 42	1 98
1911			9 20	6 03			5 19	2 98

In about sixty years the net income of the city forest of Chur, Switzerland, has increased nearly fivefold, and the famous Sihlwald, belonging to the city of Zurich, also in Switzerland, in now yielding as much as $12.00 per acre per year. The increase in net income per acre from the Chur forest is shown in the following table:

Period	Net Return Per Acre
1857—1866	$1.40
1867—1876	2.40
1877—1886	3.15
1887—1896	3.90
1897—1906	4.40
1907—1916	6.00

The foregoing estimates of yield and income may seem high, but we must remember that our eyes are continuously confronted by pictures of scrub oak, fire cherry, fire-scarred stumps, dead snags, and waste places which produce little or no wood value. We do not fully comprehend the yield possibilities of our forest land. Reliable financial calculations show that the forests of Saxony have not only paid 3% continuously in revenue, but have appreciated in value 24% by mere accumulation of material and increase in productive capacity. If we give proper care and treatment to the forests of Pennsylvania we, too, will get a high net yield, and it will not take us so long to reach the goal as it took in Europe.

CONCLUSIONS.

(1) The original forest of Pennsylvania covered at least 28,650,000 acres. The forest area of the State reached its minimum about 1900, when there were approxjmately 12,000,000 acres of forest land in the State. There are now (1922) 13,024,399 acres of forest land in the State—an increase of more than 1,000,000 acres in the last 22 years. Abandonment of mountain farms and other clearings is responsible for this big increase. It seems fair to estimate that the forest acreage will increase to approximately 14,000,000 acres by 1972. Thereafter the forest acreage is not likely to change 2 per cent in 100 years.

(2) The average acre in the original forest carried approximately 17,500 board feet of lumber and 10 cords of wood. This estimate gives a total of 501,375,000,000 board feet of lumber and 286,500,000 cords of wood in the original forest. The amount of wood in the forests of Pennsylvania has been reduced until now there remain only 11,676,211,200 board feet of lumber and 48,650,881 cords of wood, which is equivalent to about 6.2 cords on the average acre. This shows that there remains now about 1/25 of the lumber and 1/6 of the cordwood that was present in the original forest.

Of the 81,084,801 cords of lumber and wood now present in the forests of Pennsylvania, 48,526,824 cords are in the farm woodlots, 5,068,067 cords in State Forests, and the remaining 27,489,910 cords are in forests outside of the farm woodlots and the State Forests. This means that 12 cords of wood are on the average acre of farm woodlot, 4.5 cords on the average acre of State Forest land, and 3.5 cords per acre on the remainder of forest land.

By 1972 the wood in the forests of Pennsylvania should increase to 73,458,000,000 board feet and 166,950,000 cords of wood. This is equivalent to 26.5 cords per average acre, and represents an increase of 20.27 cords over that present in 1922.

(3) The present value of the forests of Pennsylvania is $134,485,116.51. This represents an average value of $10.33 per acre. A classification of the value of the forests of the State gives the State Forests an average value of $10.88 per acre, the farm woodlots are rated at $21.00 per acre, and the remainder of forest land at $4.75 per acre.

(4) During the next 50 years the forests of Pennsylvania, if given proper care and treatment, will not only increase in *volume*, but also in *quality* and *value*. The estimated value of the forests

of the State in 1972 is $1,915,060,000—an increase in value of more than $1,780,000,000. This estimated value for 1972 represents an average of $136.78 per acre, as against a present value of $10.33.

(5) In 1800 Pennsylvania stood first among the United States in lumber production. Now she holds twentieth place. In 1890 she suddenly changed from a lumber-exporting to a lumber-importing State. Now more than 84% of the lumber and 74% of the pulpwood used within the State is imported from beyond her borders. The lumber consumption has almost doubled in the last 40 years while the lumber production is less than one-fourth of what it was 20 years ago. The per capita production of lumber has decreased from 420 board feet in 1890 to 58 board feet in 1921.

(6) The low stage of lumber output in Pennsylvania has not yet been reached. It will come in about 5 years from now. The people of Pennsylvania consume annually 309 board feet per capita while the production of lumber within the State is only 58 board feet per capita. This shows that the forests of the State are supplying only 16% of the total lumber needs of the people.

(7) Our wood needs will continue to grow. Neighboring states cannot help much longer to relieve the lumber shortage. It is imperative that special efforts be put forth to increase the output of our own forest land. We have plenty of it. All that is necessary is to put the forest land to work, and there will, in time, be produced enough wood to satisfy the major needs of our people.

(8) Because of existing forest conditions in Pennsylvania, the forest growth is extremely subnormal. The forests are now producing only about one-tenth of the wood they can be made to turn out. If given proper protection and treatment, the forest growth will be increased threefold during the next 15 years, and by 1972 the average annual production will have been increased from one-tenth of a cord to a full cord per acre per year.

(9) If the annual yield of one cord per acre per year is reached by 1972, then the forests of Pennsylvania will yield annually 14,000,000 cords of wood. It is ultra-conservative to predict that they will yield 10,000,000 cords, of which 55% will be workwood (timber) and 45% fuel wood. This means that the forests of Pensylvania by 1972 will yield at least 2,400,000,000 board feet of lumber and 4,500,000 cords of wood. This output will be greater than the cut of the banner year 1900 (2,321,284,000 board feet), which stands out so prominently in the great lumbering days in Pennsylvania.

(10) What the income of the forests of Pennsylvania will be in 50 years is difficult to predict, but European experiences, and the trend of economic determining factors, indicate that the net income will be at least $2.50 per acre per year and it may reach $4.00. When restored to full production, the well-managed forests of the State will yield a net annual return of $6.00 to $7.00 per acre.

(11) Our eyes are almost continuously confronted with pictures of inferior forests. This causes us to under-estimate the possibilities of well-stocked and active forests. Reliable financial calculations show that well-managed forests of Europe have not only paid 3% continuously in revenue but at the same time have appreciated in value 24% by mere accumulation of material and increased productive capacity. There exist no reasons why our forests cannot do equally well or better.

(12) All the good that flows forth from forests is not measurable in the form of wood volume or monetary income. The intangible value of forests is often overlooked or underated. Some of the more important indirect benefits of forests follow:

a. Forests form, fix, and improve the soil. The richness of the virgin soil is proverbial. Vast areas of fertile land consist almost entirely of the detritus of the forest. One of the most important functions of the forest is the fixation of the soil. The roots of forest trees clasp and hold the soil in place, and the mulch on the forest floor protects it to such an extent that wind and water erosion are prevented. The destructive work of the waters of Lake Erie have been checked along the banks of Presque Isle by the planting of forest trees. The extent to which trees hold the soil along the banks of streams and on steep slopes, thus preventing the washing away of the soil, is enormous.

b. Forests feed springs. All the world knows that the forest cover is a great help in the maintenance and conservation of springs. In mountain regions where the forests prevail springs are most numerous. We are justified in repeating, as our forefathers declared. "The forest is the mother of the rivers."

c. Forests reduce the run-off of "wild waters". There is much less run-off in forested than in denuded regions. Extensive damage from floods occur less frequently in streams coming from the forests than from poorly forested and treeless watersheds.. In deforested regions the difference between the low water mark and the flood stage is formidable. The forest cover acts as a regulator of the stream flow. It tends to decrease the high water run-off in spring and other flood periods, and increases the low water run-off in summer and prolonged dry periods. The regularity of the run-off of streams is determined by the condition and extent of the forest cover on the drainage basin. The presence of forests checks the formation of torrents, while the absence of forest cover exposes the soil to the ravages of erosion.

On October 6—8, 1922, the Susquehanna River was only 0.6 of a foot above the bed or base rock—the lowest stage in 22 years. The water supply situation for home consumption and industrial uses was becoming serious, when a welcome and generous rainfall occurred. It would have been less serious if a normal forest cover had been present on the forest land about the river's headwaters.

In the spring of 1920 the Susquehanna River reached the flood stage. Many small towns were under water, bridges were washed away, railroad transportation crippled, and business was locally paralyzed.

The direct loss to the city of Pittsburgh from the great flood of 1907 reached the stupendous sum of $5,259,500. Nearly 1,600 acres of the city were under water. The assessed valuation of real estate affected by the flood amounted to about $160,000,000. Real estate experts estimate that the properties in the flood range are nearly $50,000,000 lower in value than they would be if the flood danger were eliminated.

The damage that floods have done in Pennsylvania would pay for the complete reforestation of all the idle acres within the State. The old truism still holds that "He who wishes to master the waters must first master the forests."

d. Forested mountains change an unruly water into a useful one. Where there are no forests heavy rainfalls become raging torrents. Much water is squandered which implies a marked decrease in water power, which is annually becoming more essential to industrial enterprise. The forests can stop this frightful loss of water and make it available for industrial use. We need a complete forest cover on our hillsides to insure a dependable water flow for the waterfalls that direct the turbines and produce power for light, heat, and industrial uses.

e. Stagnant and polluted water is rare in the forest. The most potable water comes from forested watersheds. The purity of such water helps maintain the healthfulness of millions of people who live in the cities.

f. The forests are health resorts. In affording a place where busy brains and tired bodies may find rest, diversion, pure water, and fresh air, the forest performs a beneficial service of inestimable value to mankind. History proves that when a nation loses its forests it also loses its virility. There is no place more favorable to the maintaining and regaining of health than the forest. It is there that life is simple and pure.

g. There is no better place to play and rest than in a forest environment. The forest is the most ancient of human dwelling places. How highly recreation in the forest is treasured is reflected in the sacrifices men make and the money they spend for a few days in the woods. Upwards of 450,000 resident hunters' licenses are being issued annually in Pennsylvania, and almost half as many fisherman seek recreation in the great out-of-doors. It is estimated that during 1921 at least 80,000 people enjoyed camping privileges on the State Forests of Pennsylvania. The play instinct finds its best and highest development in a forest environment.

h. Forests adorn the earth. A land dotted with beautiful forests is an enchantment to the eyes. A treeless land is as cheerless as a creedless land is hopeless. The ideal land is one in which well-kept forests cover the hillsides and dot the lowlands, and fertile fields abound in the valleys.

(13) Forests are an index of public welfare. Their products are indispensable to human progress; their wood and food, their shade and shelter, and their many other products are among our greatest needs. We can have an abundance of all these essential and beneficent forest gifts if we regard the forest as a heritage given to us by nature, not for spoil or to devastate, but to be widely used, reverently honored, and carefully maintained.

END OF NUMBER