Third Biennial Report

OF THE

STATE FORESTER

OF THE

State of Colorado

Fort Collins, Colorado
1916

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To His Excellency, Hon. Julius C. Gunter, Governor of Colorado:

Sir:

I have the honor to transmit to you the Third Biennial Report, covering the tranactions of the office of State Forester under the Act approved May 27, 1911, together with such recommendations as should tend to make this office a more effective factor for the purposes for which it has been created.

Respectfully submitted,

W. J. MORRILL,

State Forester.

THE ORGANIZATION

The State Forester, under the laws of 1911, Page 421, Section 12, is Professor of Forestry of the Colorado Agricultural College, and ex-officio State Forester. This relationship is similar to that borne by the State Entomologist, State Mining Engineer, State Chemist, and State Horticulturist, and the respective institutions to which they are attached. The State Board of Agriculture is also the State Board of Forestry. This Board is given authority by law to appoint the State Forester, who holds office at the will of the above Board, which also furnishes the State Forester with equipment and such necessary assistance as may be required for the proper conduct of the office of the State Forester. The State Forester makes frequent reports to the State Board of Agriculture.

GENERAL DUTIES

The general duties of the State Forester are prescribed by law (Law of 1911, Page 420, Section 3), summarized as follows:

To direct the management of State forest reserves, if any.

To collect and publish all data relative to the forests and other timber growing in the State.

To cooperate so far as is practical with the United States Forest Service.

To promulgate and publish rules for the prevention of forest fires, and to cause rules to be posted in forests upon State lands.

To study the best conditions for preserving and growing trees and forests.

To cooperate with the State Board of Land Commissioners in the matter of timber sales on State lands, without affecting the present authority of that Board.

To advise, aid, and assist in preventing and extinguishing forest fires anywhere in the State, irrespective of ownership of the timberland.

To investigate the cause of forest fires on State lands, either on private or public lands, and to prosecute violation of the laws pertaining to forest fires or other destruction of timber in the State.

To give instruction in forestry in the Colorado Agricultural College.

To report to the Governor biennially the transactions of the office of State Forester.

In the educational work in the Agricultural College, as a professor, the State Forester reports to the Dean of Education. In Extension Service work, or the matter of giving instruction to farmers and others throughout the State, mostly by lectures, the State Forester usually works with the Extension Service of the Agricultural College, reporting to the Director of Extension. The machinery and organization of the Extension Service makes this arrangement particularly effective. In other, but fewer instances, the State Forester works independently of the Extension Service in distributing such information.

In investigative work, the State Forester at present does not report to the Director of the Experiment Station, but is engaged in some cooperative experiments with that office.

ACTIVITIES

The general policy of this office is to confine its activities to lines not being attempted by the United States Forest Service in the State, in order that no duplication of functions may result. The excellent work of the federal forest officers in Colorado is duly appreciated. There is, however, a large and important field for forestry work left to the State Forester's office.

Upon assuming charge of this office, the following projects had been started but were unfinished.

1. Cooperative project with the United States Forest Service, described on pages 18 to 22, First Biennial Report of the State Forester, 1912.

2. The preservative treatment of fence-posts, designated as "State Forestry Investigation, Project 1", (pages 22 to 25, First Biennial Report of the State Forester, 1912).

3. Shade and timber tree survey of Colorado. State Forestry Project II, (pages 25 to 27, First Biennial Report of the State Forester, 1912).

4. Experimental tree planting, (page 27, First Biennial Report of the State Forester, 1912).

5. Cooperative Basket Willow Planting, (page 27, First Biennial Report of the State Forester, 1912).

6. Educational Extension Work, (page 27, First Biennial Report of the State Forester, 1912).

In the Second Biennial Report of the State Forester, 1914, mention is made of additional projects, which may be considered as extending the above list:

7. Demonstration in timber preservation.

8. Selection of certain lands, chiefly timber lands, aggregating 1,600 acres, to be owned by the Colorado Agricultural College, and purchased under special act of Congress from the federal Government at $1.25 per acre; this land to be devoted to forestry and high altitude agricultural investigations; and the erection of a building for field headquarters on one of the areas.

9. Free distribution of seeds, cuttings, and trees.

10. Sharing with the Colorado Agricultural Experiment Station the project in tree planting in cooperation with the federal Government at the Dry-Farm Experiment Station at Akron, Colorado.

11. The organization of the sheriffs and deputy sheriffs as a State forest fire-fighting organization.

REPORT ON ABOVE PROJECTS

1. COOPERATION IN FIRE FIGHTING WITH THE UNITED STATES FOREST SERVICE

Cooperation with the United States Forest Service, largely in fire protection, is still in force, productive of considerable valuable results, but capable of improvement, depending upon the efficiency of our organization of sheriffs as state fire wardens, to be mentioned later.

2. FENCE-POST TREATING PROJECT IN COOPERATION WITH THE UNITED STATES FOREST SERVICE

The experimental treatment of fence posts in cooperation with the United States Forest Service has not been conducted long enough to yield final results, but a progress report is herewith given.

The cooperative fence post treating project is fully outlined in the First Biennial Report of the State Forester, 1912, on Page 19. In this experiment, three species of timber, mostly from fire-killed trees taken from national forests, were used and five different methods of treating were employed. The principal preservative material used was water-gas tar creosote from the local gas plant in Fort Collins. This is a bi-product in the manufacture of water gas, and is not as antiseptic as the ordinary coal-tar creosote usually employed for the preservative treatment of timber. As it is a heavy, black liquid with the consistency of molasses at ordinary temperatures, it is incapable of rapid or deep penetration except in the most porous woods and at high temperatures. The water-gas tar creosote, however, is cheaper than the more antiseptic coal-tar creosote; the former costing $3.50 per barrel of 42 gallons, or 8 1-3 cents per gallon,

while the coal-tar creosote costs 30 cents per gallon in Denver. The crude oil was obtained from the Boulder petroleum field and with the exception of heating was used just as it came from the well.

The following table gives in condensed form the methods and results of the experiment at the end of four years, as found by inspection by the State Forester:

NUMBER OF POSTS AND TREATMENT

SPECIES	Untreated	Two coats hot water-gas tar, brushed on 12 hours apart	Two hours in hot water-gas tar, in open tank	Two hours in hot water-gas tar, allowed to cool 20 hours in open tank	One hour in hot water-gas tar, allowed to cool 1 2/3 hours in open tank	Two coats hot crude oil, brushed on 12 hours apart	Sound at end of 4 years. Percent
Alpine Fir ..... (Fire-killed)	10	—	—	—	—	—	57
	—	10	—	—	—	—	95
	—	—	10	—	—	—	100
Lodgepole Pine..... (Fire-killed)	20	—	—	—	—	—	26
	—	20	—	—	—	—	82
	—	—	20	—	—	—	94
	—	—	—	20	—	—	99
	—	—	—	—	20	—	99
	—	—	—	—	—	20	32
Engleman Spruce ..... (Cut green and seasoned 12 months)	20	—	—	—	—	—	47
	—	20	—	—	—	—	77
	—	—	20	—	—	—	81
	—	—	—	20	—	—	98
	—	—	—	—	20	—	98
	—	—	—	—	—	20	32

3. SHADE AND TIMBER TREE SURVEY OF COLORADO

The shade and timber tree survey of Colorado has not been carried out as planned, except in Fort Collins. It appears best to modify the plans as follows: Upon application from any town or city in Colorado, the State Forester will make a survey of the street trees, after which plans will be submitted for definite action, giving estimate of cost and precise nature of the improvements recommended. The proper arrangement, spacing, and choice of species, protection of the trees by tree-guards, and care of street trees are matters of considerable concern to many eastern cities, but little thought has been given to the subject as yet in Colorado cities.

The demand for street tree reforms must be created by educational means, after which the State Forester will be in a position to be of more assistance. During the past year, considerable study has been made of conditions of our street trees as well as concerning the species found suited to various parts of the State. Emphasis has been made, through the press and by lectures, of the desirability of using a single species of tree on each street, all in alignment, trees widely spaced and properly guarded from injury. Special attention has been paid to treeless towns in eastern Colorado, where the errors in street tree planting of the older towns have not yet been made. As a phase of this project, the State Forester is gradually ascertaining from personal observation, and in a less measure from correspondence, the species of trees hardy and suitable for planting in various localities in the State.

4. EXPERIMENTAL TREE PLANTING

Experimental tree planting in the College nursery has been conducted long enough to obtain a fair idea of what species thrive in and around Fort Collins. This planting will form the nucleus of an arboretum. The project will be continued with new species. Following is a brief report:

In the spring of 1905, the Experiment Station purchased and set 51 species of trees on the college farm for the purpose of testing their suitability for northern Colorado. The stock, which was secured from a nursery in Kentucky, was in part rather large when planted and the long journey permitted many of the trees to start into growth while on the way. It appears, moreover, that the mild climate in which the stock was produced may have had some influence in determining the loss of certain species lacking in hardiness under our conditions. At least, some of the species which at first failed have later succeeded when secured from nurseries farther north. The following table shows the results of the first planting:

Species	Number Planted	Number Survived 1916	Remarks
Alder, European	10	0	Failure
Ash, Black	25	25	Hardy
Ash, Blue	25	8	Half hardy
Ash, Green	25	25	Hardy
Ash, Wafer	10	6	Hardy
Basswood	25	0	Half hardy; survivors dug out

Beech, American	10	0	Failure
Beech, Blue	10	0	Failure
Birch, Canoe	5	0	Failure
Birch, Cherry	5	0	Failure
Birch, White European	25	1	Half hardy
Birch, Yellow	5	0	Failure
Buckeye	10	5	Hardy
Cherry, Wild	25	2	Half hardy
Chestnut	25	0	Failure
Coffee Tree	25	8	Half hardy
Dogwood	25	0	Failure
Elm, American	25	0	Survivors dug out
Elm, Scotch	25	0	Survivors dug out
Elm, Slippery	25	0	Failure
Hackberry	25	0	Failure
Hawthorn, Cockspur	10	0	Survivors dug out
Hawthorn, English	10	0	Survivors dug out
Hawthorn, Scarlet	10	2	Hardy
Hickory, Bitternut	25	2	Half hardy
Hickory, Shagbark	25	3	Half hardy
Horse Chestnut	10	0	Failure
Iron Wood	10	0	Failure
Locust, Honey	25	10	Hardy
Maple, Mountain	10	0	Failure
Maple, Norway	25	3	Half hardy
Maple, Red	10	0	Failure
Maple Soft	25	0	Half hardy; survivors dug out
Maple, Sugar	25	0	Failure
Maple, Tartarian	10	10	Hardy
Mulberry, Russian	25	0	Survivors dug out
Mulberry, White	25	0	Failure
Oak, Bur	10	10	Hardy
Oak, English	10	2	Half hardy
Oak, Pin	10	2	Half hardy
Oak, Red	10	1	Half hardy
Oak, Scarlet	10	0	Failure
Oak, Swamp White	10	1	Half hardy
Oak, White	10	0	Failure
Olive, Russian	25	25	Hardy
Pea Tree	25	25	Hardy
Redbud	10	0	Failure
Sycamore	25	0	Failure
Tulip Tree	25	0	Failure
Yellow Wood	5	0	Failure

The results of the foregoing experiment should not be taken as conclusive in regard to the hardiness of the species planted, except for this particular lot of trees. Individuals of the following species of trees, which appear from this trial to be lacking

in hardiness here, are found growing successfully upon the College campus and in the adjoining city of Fort Collins:

Hackberry	Norway maple
Sycamore	Soft Maple
Scarlet Oak	Sugar Maple
Slippery Elm	Buckeye
Basswood	White Birch

Most of the failures were due to injury received during our dry, cold winter season, which is especially trying to trees adapted only to climates with a high relative atmospheric humidity and a winter ground-cover of snow. A number of the above species continued to exist until dug out, sending up a more or less vigorous growth of sprouts from the root crown during the summer, only to be killed back during the winter. Occasionally a favorable winter would enable the stronger individuals to survive and in such cases a few specimens have succeeded in growing to some size but with the frequent loss of branches or even of the whole crown.

Later plantings have been made with stock from Massachusetts, Connecticut, Illinois, Kansas, Iowa, Nebraska, and Colorado nurseries, together with some species from the Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C. The following list gives the results thus far of these plantings:

Species	Number Planted	Date	Number Alive in 1916	Remarks
Ailanthus	5	1912	1	Half hardy
Arborvitae, American	5	1911	1	Half hardy
Arborvitae, Chinese	25	1914	25	Quite hardy
Ash, European Mountain	5	1913	3	Hardy
Basswood (T. dasystyla) European	3	1912	...	...
Basswood (T. grandifolia) European	50-S	1912	...	...Failure
Basswood (T. platyphyllos) European	5	1912	...	...
Basswood (T. vulgaris) European	5	1911	3	Quite hardy
Beech (silvatica) European	50	1912	...	...Failure
Beech, American (atropunicea)	5	1911	...	...Failure
Beech, European	50	1912	...	...Failure

Birch, European White	50	2 yr.	1912.	45	Quite hardy
Birch, Native Black		5	1912.	5	Hardy
Birch, Yellow		5	1911.		Failure
Catalpa, Hardy					Nearly hardy
Cedar, Eastern Red		25	1912.	24	Hardy (Colorado grown)
Cedar, Rocky Mountain Red		2	1911.	2	Hardy
Cedar, Alligator-Bark		5	1912.	1	Half hardy
Cedar, (J. schottii)		5	1912.		
Cedar, Swedish		9	1912.		Quite hardy
Cherry, Native Choke		5	1913.	5	Hardy
Cherry, European Bird		5	1912.	5	Hardy
Chestnut, Sweet		5	1911.		Failure
Crabapple, Eastern Wild		5	1912.	5	Hardy
Elm, American		5	1911.	5	
Elm, English		5	1911.		
Elm, Scotch		5	1912.	4	Nearly hardy
Elm, (parvifolius)		1	1912.	1	Nearly hardy
Fir, Native Alpine					Hardy
Fir, Eastern Balsam		5	1911.	1	Half hardy
Fir, Native Concolor		5	1913.		Hardy
Fir, Nordmann's European		5	1913.	1	
Fir (pectinata) European		50-S	1912.		Failure
Fir, Veitche's, Asia		5	1913.		
Ginkgo, Japan		5	1913.	1	Half hardy
Hemlock, Eastern		4	1913.		Failure
Larch, European		10	1911.	10	Hardy
Locust, Native New Mexican		5	1912.	5	Hardy
Locust, Black					Hardy
Maple, Native Smooth		5	1912.	5	Hardy
Maple, Norway		5	1911.	5	Quite hardy
Maple, Norway		100	1912.	100	Quite hardy
Maple, European		5	1912.		
Maple, Sugar		5	1911.	4	Quite hardy
Maple, English		5	1912.	4	Half hardy
Oak, Native Scrub		5	1912.		Failure
Oak, Bur		25	1913.	25	Hardy
Osage Orange		10	1911.	2	Not hardy
Pine, Austrian		100-S	1912.		Hardy
Pine, Swiss Stone		5	1913.	3	Not quite hardy
Pine, Jack		8	1913.		Failure
Pine, Pinon, Native		10	1913.	10	Hardy
Pine, Native Limber		5	1913.	5	Hardy
Pine, Larch		100-S	1912.		Failure
Pine, European Mountain		2	1912.	1	Hardy
Pine, Eastern White		200-S	1912.	5	Half hardy
Pine, Western White		10	1911.		Failure
Pine, European Dwarf Mountain		100-S	1912.		Quite hardy

Pine, Western Yellow	Raised from seed.	...		...Hardy
Pine, European Scotch	5	....1911.	1	...Quite hardy
Pine, Thunberg's Japan	100-S	....1912.		...Failure
Plum, Native Wild	5	....1913.		...Hardy
Poplar, Carolina	....	....		...Hardy
Poplar, Bolley's European	5	....1912.	4	...Hardy
Poplar, Native Balsam	....	.....		...Hardy
Poplar, Chinese, Asia	10	....1912.		...Hardy
Poplar, Native Aspen	....	....		...Hardy
Spruce, Black Hills	10	....1911.	10	...Hardy
Spruce, Native Engelmann	....	....		...Hardy
Spruce, Norway, European	10	....1911.		...Failure
Sycamore	10	....1911.		...Failure
Walnut, Black	Raised from seed.	...		...Hardy
Willow, Weeping, European	1	....1912.	1	...Hardy
Willow, Niobe Weeping	2	....1905.	2	...Hardy
Yew, Japanese Dwarf	1	....1913.	1	...Hardy

The land devoted to these experiments consists of a stiff loam soil, upon which alfalfa and sugar beets would thrive. As the arboretum is in an exposed situation, the trees which have succeeded are very properly counted as hardy for conditions similar to those which prevail here. Some of the species which have been assigned to the half-hardy class are often capable of doing well in more sheltered situations in our locality, or in more exposed sites under milder climatic conditions. Most species of trees are more tender during the first few years than later in life, acquiring a greater degree of hardiness with age, especially after the main trunk becomes established. If it is possible to get them through one or two winters without severe injury, they may survive and make a fair growth during succeeding years. This fact will often account for the survival of a few individuals from among a considerable number originally planted.

5. Cooperative Basket Willow Planting

In the spring of 1911, three species of basket willows were secured from the United States Department of Agriculture, Bureau of Plant Industry, for experimental planting at this Station. The cuttings were planted in a single row upon the same piece of land as the experimental trees previously described. Additional cuttings, including more varieties, were secured from the same source and planted the following spring in the form of a small holt. This test includes the following standard basket willow varieties grown in the United States and Europe:

American Green Willow
Vinalic Willow
Disyclados Willow
Caspian Williw
Lemley Williw
Purple Willow

These were planted in eight rows, 50 feet long and 3 feet apart, the plants being spaced 1 foot apart in the row. They have been cultivated and irrigated the same as the experimental trees and have therefore received less water than is usually applied to basket willows for the best results. The rods have been harvested each season since the first spring, and last season a quantity of the better ones were peeled, a portion being turned over to the Domestic Science Department of the College, where they have been used in the making of baskets. While some of the varieties tested showed a lack of hardiness and thrifty growth, the following kinds were particularly successful: Purple, American Green, and Caspian. The first two varieties produced from seven to eight rods per plant with an average length of 52 and 48 inches, respectively, at the end of the first season. The three varieties mentioned have since produced many rods over 6 feet in length, and some from 8 to 9 feet, in one season.

As to quality, the rods appear to be rather stiffer and harder to work with, in basket making, than those grown in the eastern states; however, this may be due largely to the way in which they were grown, and can possibly be remedied by a freer use of water during the growing season.

6. Educational Extension Work

Beginning in November, 1915, and continuing until the middle of March, 1916, the State Forester was engaged chiefly in lecturing in all parts of Eastern Colorado, at farm institutes organized by the Extension Service of the Colorado Agricultural College. During this interval, 95 lectures were given, 2,500 miles were covered, and 5,500 people were addressed, mostly in small meetings of from 40 to 60 people, often in remote districts. Special attention was paid to Morgan, Kit Carson, and Lincoln Counties, because of the enthusiastic cooperation of the county agricultural agents of those counties. This work is said to have been partly responsible for rather extensive tree planting, especially in Morgan county. In addition to speaking on the subjects of planting windbreaks, ornamentation of the farm home, and the beautifying of school grounds, the matter of preservative treatment of fence posts and other timbers subject to rapid decay was discussed.

7. DEMONSTRATION IN TIMBER PRESERVATION

Demonstrations in timber preservation were given at the Boulder County Fair in 1915, and at the International Stock Show in Denver in 1916. A small, practicable apparatus, costing $45.00 for the preservation treatment of fence posts on the farm was exhibited. This apparatus has also been used for treating posts on the college farm in Fort Collins, and on the sub-station farm in Cheyenne Wells. Partly from our own experiments, but chiefly from experiments carried on by the State Forester of Iowa, we are teaching that fence posts from such cheap and naturally non-durable woods as Soft Maple, Cottonwood, Willow, White Elm, and Lodgepole Pine may be treated with coal tar creosote at an expense of about 10 cents each and thereby can be made to last approximately 25 years.

8. SELECTION OF THE COLLEGE FOREST

The selection of the College forest lands was completed largely by my predecessor. During seven weeks in the summer of 1916 the State Forester surveyed, mapped, and estimated the timber on the areas chosen. Several alterations in the original selection were made, and the filings amended as follows:

Subdivisions	Sec.	Tp. 7 N R. West, 6 P. M.
NE¼ NW¼, NW¼ NE¼, SE¼ NE¼	13	74
SW¼ NW¼	18	73
S½ SW¼, S½ SE¼	18	73
SE¼ SE¼	17	73
SE¼ SW¼	16	73
W½ NW¼	30	73
S½ SE¼	30	73
NE¼ SE¼	30	73
W½ SW¼	20	73
NW¼ NW¼	29	73
SW¼	21	73
E½ NW¼	6	72
W½ NE¼	6	72
NW¼ SE¼	8	72
S½ NE¼, N½ SE¼	18	72
N½ NW¼	16	72
NE¼ SW¼, N½ SE¼, SE¼ NE¼	29	72
NE¼ SE¼	23	70
SW¼ NE¼, NW¼ SE¼	26	70

The total area is approximately 1,600 acres, and the estimated stand of timber is nearly nine million board feet. In addition, there are many acres of saplings which at present cannot

be assigned values in board feet. If 1,000 or 1,500 acres more of good timberland in the same vicinity can be purchased, the College forest can be organized as a unit capable of producing a sustained annual yield of sufficient volume to supply perpetually a small sawmill the year around and yielding an annual rental.

9. Free Distribution of Seedings, Cuttings and Trees Proposed State Forest

Free distribution of seeds, cuttings, and trees has been discontinued because of the belief that what is furnished gratis is not valued as highly or is as well cared for as what is purchased. In place of free distribution of a very limited supply of trees, such as the funds at the disposal of this office for that purpose could furnish, it seems better to offer the farmers an opportunity to purchase at cost of production trees of suitable species and sizes.

The question of establishing a state forestry nursery to supply the material needed was given careful consideration and was discarded in favor of a proposition to contract with the United States Forest Service to grow such nursery stock in their large nurseries in Halsey, Nebraska, and at Monument, Colorado. The Forest Service is willing to cooperate in this way, and forty thousand trees are being grown under contract.

It is believed that the extensive Government nurseries can produce the stock cheaper than a comparatively small state nursery could. Moreover, the soil of the Experiment Station Farm in Fort Collins is rather heavy for a forest nursery.

The commercial nurseries, as a rule, do not meet the class of business calling for very small trees in considerable numbers at a small price per hundred or thousand. The Forest Service is growing under contract such species of trees as will thrive in Colorado; the State Forester will handle the orders from the purchasers in order to check upon the feasibility of growing the desired species in the localities intended, and will give advice in planting and care, besides ascertaining where to go to inspect the plantations in later years. This plan will be put in operation in the spring of 1918.

10. The Akron Tree-Growing Experiment

The history of the beginning of the experimental planting of trees in Akron, Washington County, Colorado, is given in the Second Biennial Report of the State Forester. From an inspection made by the State Forester in June, 1917, it may be said that the trees as a whole present a fine appearance in this windy

plains region where shelter planting is greatly needed, and the groves or shelterbelts are becoming yearly more valuable.

Among the hardwoods the most valuable species are Hackberry, Black Locust, Russian Olive, White Elm and Honey Locust. The Hackberry has not made as rapid growth as the Locusts, but it has suffered less from winter-killing, drought and wind injury. It should be held in mind that these shelterbelts are being grown without any irrigation in a region where the average elevation is 4,650 feet and the annual precipitation is 22 inches, fortunately comparatively heavy during the vegetative season, but with a relative humidity of from 50% to 55%, a frostless season of from 125 to 150 days, a high percentage of cloudless days, high temperatures, strong winds and heavy evaporation from the soil and rapid transpiration from the foliage.

The Russian Olive gives promise of being especially desirable in windbreaks because of its low branching habit, and appears much more hardy as to winter-killing than the Mulberry growing nearby. In fact, the latter species was not at all successful. Green Ash not only grows slowly here but a large percentage of the trees had been attacked by borers, not only at the Experiment Station but on the court-house grounds in Akron.

While the White or American Elm was found to be of rather uneven growth and winter-kills slightly, it still is worthy of use in planting in this region.

Black Locust was successful and free from the black locust borer, which makes the planting of this species inadvisable near Denver and Boulder and near the Kansas boundary.

But of all the species tried the conifers used appeared best adapted to the climate. Of these, Jack Pine (*Pinus divaricata*, or *P. banksiana*) and Western Yellow Pine (*Pinus ponderosa*) give great promise, the former making the best growth and showing at present; while the Western Yellow Pine may outgrow the Jack Pine within a few years. The Rocky Mountain Red Cedar, unfortunately, was not planted, but from observations made in various parts of eastern Colorado this species thrives satisfactorily in this region.

Perhaps the greatest value of this experiment will be found in the establishment of a growing conviction that conifers will prove better than broad-leaf species in the non-irrigated region of eastern Colorado. This will not be surprising, especially as we know that conifers as a class require only a fraction of the moisture demanded by broad-leaf species, as a class, but, on the

other hand, the leaves of the conifers are transpiring moisture during the winter, when the frozen earth cannot yield its moisture to supply the current to the leaves, resulting in drying out and death of the coniferous leaves. There is a strong indication at present that winter-killing of coniferous foliage will not prove unduly serious.

While the shelterbelts at Akron have been given good care, nothing has been done which any farmer could not do in that region. Careful cultivation has been given to keep down weeds. It is advisable to experiment here with conifers, giving them no cultivation, since at Halsey, Nebraska, with the same average annual precipitation, success is being made in growing Jack Pine and Western Yellow Pine without cultivation; and other extensions of the general experiment can be made advantageously.

The following species, planted in 1909 and 1910 on the Akron Experiment Station, are reported by Superintendent O. J. Grace as follows:

PLANTING DONE IN 1909

Species	Height Feet. in 1916	Condition in 1916
Honey Locust	9-14	Fair
Cottonwood	18-25	Poor to Fair
Green Ash	6-12	Poor
American Elm	7-14	Fair
Black Cherry	7-10	Good
Osage Orange	8	Good—kills back badly during the winters
Russian Olive	10-15	Good
Russian Mulberry	5- 9	Poor
Black Locust	12-18	Good

PLANTING DONE IN 1910

Species	Height Feet. in 1916	Condition in 1916
Honey Locust	8-16	Good
American Elm	8-15	Good
Hackberry	8-15	Good
Black Locust	10-16	Good
Russian Mulberry	5- 8	Poor
Catalpa	- 3	Poor —kills back badly during the winters
European Larch	None living	
Scotch Pine	2.5-5.5	Good
Austrian Pine	4- 8	Good
Jack Pine	6-11	Good
Western Yellow Pine	3- 4	Good
Black Hills Spruce	3- 4	None living
Douglas Fir	0.5-2.5	Good

II. STATE FIRE-FIGHTING ORGANIZATION

Sample of Posters Circulated During Past Year

The organization of the sheriffs and deputy sheriffs as a state fire fighting organization, as reported in the Second Biennial Report of this office, was effected in 1912. and a visit was paid to the sheriffs of the 42 counties having more or less timber. The State Forester has acted as an advisor to the sheriffs in their duties as fire wardens He has required reports from them each year in order that forest fire statistics may be compiled. The office has also endeavored by letters and, when convenient, by personal interviews, to impress upon these officers the seriousness of their duties as fire wardens.

In the main, the sheriffs have responded well to these duties. In one instance, however, a sheriff refused to continue fighting a forest fire when he learned that the state had no fund with which to pay the bills. According to the law, the funds must be furnished by the counties. In most cases the sheriff obtains authority from the county commissioners before incurring expense in fire fighting. This should be an unnecessary procedure, but as the law states, "The county commissioners may allow the sheriff five dollars per day for such services..... and such other expenses necessarily incurred as they may deem just," the sheriffs will not, of course, assume any responsibility for incurring expenses without special authority. In order to save delay in a number of counties, resolutions have been passed, at the

Sample of Posters Circulated During Past Year

instance of this office, authorizing fire fighting expenditures incurred by the sheriffs at any time necessary.

In order to encourage better fire fighting by the counties the State Forester introduced a bill into the last state legislature asking for an appropriation of $1,000 for each biennium to reimburse the counties for fighting fire on state timber lands. The bill did not succeed. The United States Department of the Interior was also approached in regard to guaranteeing reimbursement of the counties for fighting fire on public domain timber lands, but no change was effected in the present procedure, which necessitates telegraphic communication with Washington in each case, after the fire, of course, is already under headway.

Because of the difficulty in obtaining fire reports in some instances, the list of fire reports in this office is admittedly incomplete and therefore it is believed best not to include it in this report. A more accurate system of reporting has been inaugurated in cooperation with the United States Forest Service, which should result in practically complete records in the future.

Very recently the State Forester has been equipped with an automobile, fire fighting tools and other equipment which will permit of prompt visits to fires in northern Colorado. New state fire warning notices have recently been printed by this office and quantities sent to sheriffs and other state officers to be posted generally in timbered areas outside of the national forests and anywhere on state timberlands.

NEW PROJECTS PLANNED

Besides carrying on the old projects, it is proposed to inaugurate the following new projects:

1. The study of the economic value of windbrakes or shelterbelts in conserving soil moisture in the protected area has been carried on chiefly in eastern Nebraska and eastern Kansas. From the results determined by the few investigators of this subject it appears that shelterbelts have considerable economic value, especially around orchards and even in protecting field crops. It seems highly desirable to test the value of windbreaks under the climatic conditions presented in portions of Colorado.

2. The State Forester proposes to strengthen the instruction in professional forestry in the Colorado Agricultural College until the department shall rank high among the institutions offer-

ing forestry courses in the Rocky Mountain region. During the past year he has provided a good equipment to this end by building up an almost complete library in English on the subject, by providing a good assortment of instruments used by foresters, and in partially organizing the "field laboratory" of 1,600 acres of timberland, known as the College forest, west of Fort Collins. In addition to this, the curriculum in forestry has been revised and extended.

FINANCIAL STATEMENT
STATE FORESTER APPROPRIATION FUND
FOR THE YEAR ENDING NOVEMBER 30, 1916

Receipts—		
Balance in fund December 1, 1915	$ 7,873 28	
Transferred from The State Board of Agriculture Land Fund	2,000 00	
Disbursements—		
Apparatus		1,053 77
Freight and Express		69 74
Furniture and Fixtures		817 29
General and Laboratory Supplies		84 80
Labor		854 73
Laundry		25
Permanent Improvement (Field Laboratory Headquarters)		2,162 12
Postage and Stationery		377 27
Publications		155 66
Repairs		52 80
Salaries		3,331 56
Telephone and Telegraph		9 81
Tools and Scientific instruments		518 55
Traveling Expenses		384 93
	$ 9,873 28	$ 9,873 28

STATE FORESTER (APPROPRIATION)
FOR THE YEAR ENDING NOVEMBER 30, 1915

Receipts—		
From State Treasurer	$10,000 00	
Disbursements—		
Freight and express		$ 15 80
Furniture and fixtures		142 58
General and laboratory supplies		12 45
Labor		187 85
Permanent improvements		58 50
Postage and stationery		13 39
Publications		54 55
Salaries		1472 74
Telephone and telegrams		5 90
Tools, implements and machinery		2 55
Travel		160 41
Balance		7,873 28
	$10,000 00	$10,000 00

PUBLICATIONS

To date, the following publications, besides the present report have been issued from this office:

"First Biennial Report of the State Forester, 1912."
"Forestry Laws of Colorado, Compiled 1912."
"Instructions for County and State Fire Wardens, 1912."
"Second Biennial Report of the State Forester, 1914."
"The Evergreens of Colorado."—B. O. Longyear.
Publication No. 1, 1914.
"Trees for Non-Irrigated Regions in Eastern Colorado."—W. J. Morrill.

RECOMMENDATIONS

PROPOSED STATE FOREST

It is stated on good authority that 125,000 acres of State timberland are included within the national forests in Colorado. The State holdings are mostly Sections 16 and 36 in each township; in a few places several sections are found in one body. In some townships the State land has been sold. Assuming that these scattered school lands are chiefly valuable for timber, the most reasonable thing to do would be to effect an exchange with the federal Government whereby the State would receive 125,000 acres, or whatever the aggregate acreage of these school lands may amount to, in one compact body or in a few compact bodies, of value and acreage equivalent to that conveyed to the Government. From a forestry standpoint this would be highly desirable for the following reasons:

1. The best forestry practices can only be applied to large bodies of timber, sufficiently large to make an independent business of lumbering on a substantial yield basis. Forestry cannot be successfully conducted on scattered sections any more than agriculture could be satisfactorily conducted by a man owning 160 acres in acre lots scattered over a county.

2. The land in large compact bodies could be more easily protected from fire, theft, and insect attacks.

3. Not only can better forestry be practiced on large bodies of timberland, but the State would feel a certain pride in a real State forest, which might serve for recreational purposes as well as for providing a steady, annual income from timber sales and grazing.

4. Better supervision, inspection, and more intensive utilization of the land would be possible, and with all this, more responsibility to the officers in charge.

5. The location of the proposed State forest could possibly be made to cover known mineralized country, thereby not detracting from, but rather adding to, the chances for developing mining properties on State lands.

6. The location of the proposed State forest might be made accessible to railroads, whereas much of the school timberlands are at present remote from railroads or markets.

7. Under the present system of management of these scattered State school lands, there is no permanent policy as to the future use of the land. A section or portion of the section may be sold at almost any time. Under these conditions, no forester, and probably no State Land Board, feels justified in incurring present financial sacrifices in hopes of greater future gains in the handling of timber sales. Consequently, good forestry is not practiced, and the eventual highest possible income from these lands is overlooked in the present management. The land is not intensively classified with the view of devoting each acre to its highest, most remunerative use. All these desirable and economically sound principles can be applied only in case an erchange is effected and the State lands are managed in large blocks. Similar exchanges have been made, or are being negotiated, with South Dakota, Montana, Idaho, and Washington. The consummation of three of these states exchanges now awaits final approval by Congress. In the exchange, federal and state officials together visit the areas in question and appraise values.

It is only reasonable to assume that with the exhaustion of the virgin forests of the United States stumpage will gradually rise and eventually gain a value commensurate with the cost of growing timber under forestry practice, besides yielding a profit on the investment. Colorado, then, should not lightly value its timberlands, but should be making preparations to make the most possible out of them, placing them in shape, and looking forward to the time when they shall become a source of perpetual, direct income. In fact, today, accessible, well handled timber land yields considerably higher returns in the form of timber growth than the same land or similar land would yield if leased for grazing.

The indirect value of well-handled timberlands in this State is incalculable, influencing irrigation and maintaining scenic advantages, besides providing for wood-working industries which

distribute in wages several dollars for each dollar in stumpage cut. It behooves the State of Colorado, the first to make provisions for forestry in its constitution, to take steps at once to place its timbered holdings in a position to serve the best interests of the State.

Respectfully submitted,

W. J. MORRILL,

State Forester.