STATE OF MINNESOTA

Luther W. Youngdahl, *Governor*

Department of Conservation

Chester S. Wilson, *Commissioner*

Ninth Biennial Report

1947-1948

Section II

DIVISION OF FORESTRY

H. G. Weber, Director (Deceased Oct. 1, 1948)

Clarence Prout, Director from Oct. 13, 1948

This report is published in six sections as follows:

I. Commissioner's Report, covering general departmental activities and summarizing the data and recommendations pertaining to the several divisions.
II. Division of Forestry
III. Division of Game and Fish
IV. Division of Lands and Minerals
V. Division of State Parks
VI. Division of Water Resources

"All of our aims for better living will fail if we fall short in protecting our heritage of natural resources—from which, directly or indirectly, we draw all income, all tax revenue, and all means of existence. We rob the future by wasting today."

From Inaugral Address of Governor Luther W. Youngdahl, to the Legislature of 1949.

January, 1949

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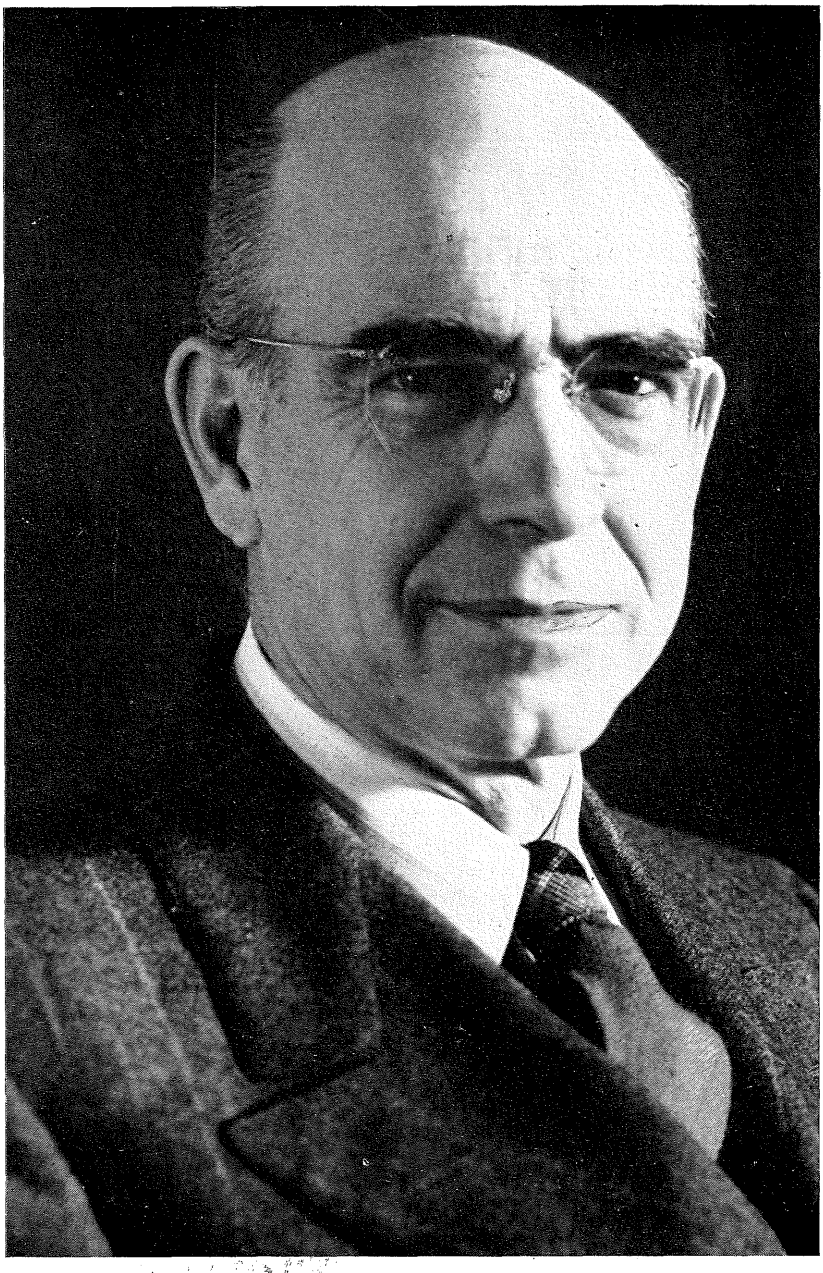

HENRY G. WEBER—1886-1948

HENRY G. WEBER

1886-1948

In Memoriam

That there is a depth and a breadth to life as well as a length was the philosophy of Henry G. Weber. He never spared himself in his zeal to do his utmost for the progress of forestry in Minnesota.

It has been said of him that he toiled as no man had ever toiled before in the fields of fire prevention, forest management, and the wise use of our timber resources. He was a man of vision. At the same time he was endowed with good, common sense, and his sights were never raised so high that he overlooked the people associated with him. He had the welfare of the division's personnel always at heart.

He was one of the "old timers" in the Minnesota Forest Service, starting, as he did, in April of 1913, shortly after its organization. Except for a few years when he was engaged in private business, he was with the service until death ended his forestry career on October 1, 1948.

For nine years previous to his death he was director of the division of forestry, and these years saw great gains made toward restoring Minnesota to leadership in the field of forestry.

To those whose privilege it is to continue the work so well begun, is given the task of bringing to fruition his great plans for forestry's future —of carrying forward the banner that "Heinie" Weber raised aloft.

To the Honorable Luther W. Youngdahl, Governor

and

To the Legislature of the State of Minnesota:

I have the honor of transmitting herewith the biennial report of the Division of Forestry, of the Department of Conservation, for the biennium ending June 30, 1948, being Section II of the Ninth Biennial Report for the entire department.

For the convenience of people interested only in certain parts of this material, the commissioner's report and the reports of the five divisions are published separately for this biennium, instead of being in a single volume as formerly.

The last previous report (Eighth Biennial), was the first report after the close of the Second World War. In that report we included a complete review of the condition of the natural resources of the state—soil and minerals, forests, waters, and wildlife—as affected by the war and other conditions. We also outlined a comprehensive program for the effective care and wise use of all these resources, to the end that the means of existence and the opportunity for a more abundant life may be preserved for present and future generations. The present report does not attempt to go over the same ground in detail, but is designed to include such additional material as is necessary to bring the conservation record and recommendations for future action up to date.

Respectfully submitted,

Chester S. Wilson
Commissioner of Conservation

Hon. Chester S. Wilson
Commissioner of Conservation
St. Paul 1, Minnesota

Dear Sir:

The report of the Division of Forestry for the biennium beginning July 1, 1946, and ending June 30, 1948, is transmitted herewith.

It was prepared by and under the direction and supervision of H. G. Weber, who was director of the division until his untimely death on October 1, 1948.

Yours very truly,

Clarence Prout, Director
Division of Forestry

January, 1949

DIVISION PERSONNEL

Clarence Prout	Director
Elizabeth Bachmann	Secretary
Anson E. Pimley	In Charge of Fire Control
Arthur K. Anderson	Assistant in Fire Control
Wm. M. Byrne	Locomotive Fire Protection Inspector
Raymond Clement	In Charge of Nurseries and Planting
J. C. Gannaway	In Charge of State Timber
Anastasia M. Gorman	Secretary
Edward L. Lawson	In Charge of Forest Management
Howard B. Munson	Executive Assistant
Arthur F. Oppel	In Charge of Special Projects
Harold Ostergaard	In Charge of Recreation and Lands
Lloyd G. Owen	In Charge of Inventory
Roger Williams	Civil Engineer

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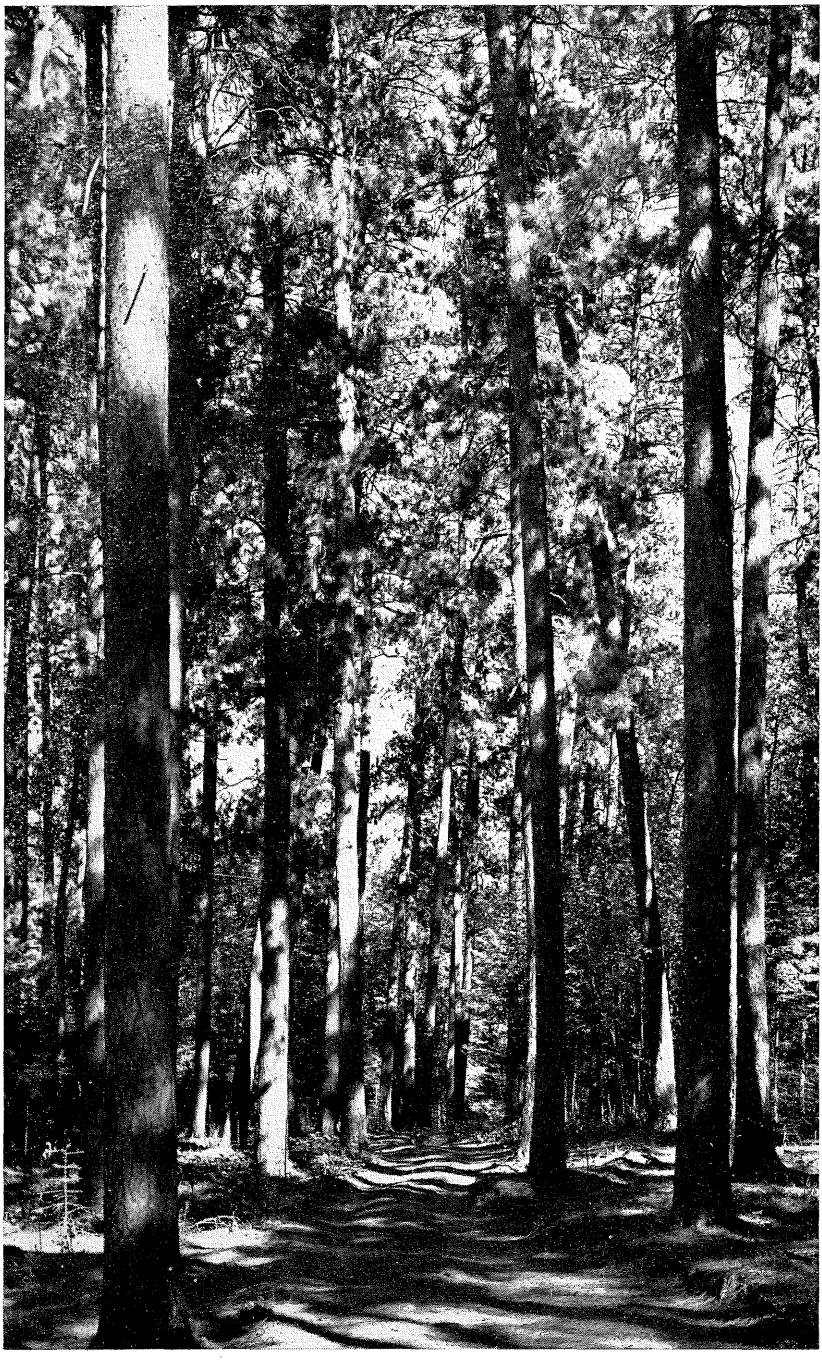


Woodland trail in one of Minnesota's forests.

Division of Forestry

H. G. WEBER, *Director*

INTRODUCTION

It may be said that the foundations for the division of forestry and its predecessors were laid on tragic footings.

The Hinckley-Sandstone forest fire of 1894, which took 418 lives and destroyed property of great value, aroused public sentiment and resulted in the laws passed by the legislature of 1895 which set up the first state organization to prevent and combat forest fires.

This organization of fire wardens on a strictly volunteer basis, paid only for actual fire fighting, struggled along rather ineffectually until the little towns of Baudette and Spooner were wiped out by a forest fire in 1910 and 42 persons lost their lives. This tragedy gave further impetus to legislative action and in 1911 the legislature created the first Minnesota forest service with an appropriation of $75,000 per year for the first two years. The first organization was made up a few staunch woodsmen headed by a state forester.

The people of northern Minnesota in what later proved to be an over-development of lands more suitable for forests than for agriculture, adopted fire as a cheap land clearing tool, but while this may have been to them a ready means of clearing forested lands, at the same time it created a fire problem too large to be effectively dealt with by the small under-financed forest service.

In 1918 uncontrolled fire again struck through the forest region and destroyed millions of dollars worth of property, wiped out the thriving towns of Cloquet, Moose Lake, and several smaller communities, threatened the destruction of the city of Duluth, and took the lives of 438 people. This again focussed public attention on the need for better fire protection and the legislature responded. Severe fires in 1922, 1923, 1936 and 1938 kept the public fire-conscious and small gains were made toward a more adequate forestry organization.

The state forestry organizations were thus founded on the need, as demonstrated by sad experience, for the protection of the people and the land from forest fires. Each catastrophe advanced the cause of forest fire protection, but at no time has the problem been considered in its entirety and sufficient funds appropriated to do the job. These organizations realize that once these forest lands produced timber which, when harvested, placed Minnesota in second place among the states as a timber producer. They know that these lands now, even though abused in the past, support wood using industries whose products brought over 128 million dollars into the state in 1947, and that proper care and use of forest lands will sustain an

increased yield of timber and enable an expansion of these industries and the development of other new ones.

This awakened public interest will result in the recognition of the need for an all-out conservation program, but it is hoped that progress will be made at a more rapid pace and without the prodding of further catastrophes.

The threat of fire is ever present in forested areas, as attested to by the recent Maine forest fire disaster, and it is well for the people of Minnesota to keep this in mind. The people know that the recreational values of these forest lands, the production of game and fish, and the maintenance of the many beautiful lakes depend in great part on the proper use of the forest lands.

Perhaps the most effective way in which to call public attention to the need of providing additional funds for the protection and suppression of forest fires in Minnesota is to compare appropriations made available for this purpose with what is being supplied nearby states with comparable conditions.

In Wisconsin the total moneys available for forest fire prevention and suppression for last fiscal year averaged 6.7 cents per acre. In Michigan the total available last fiscal year averaged 8.4 cents per acre. In Minnesota, which has a larger area to protect (approximately 20,000,000 acres), the amount available averaged only 3.8 cents per acre.

In 1945 reports were prepared for the federal forest service by the lake states indicating the amounts necessary to give adequate fire protection within the area. Based on these reports, the cost per acre for adequate protection for Wisconsin averaged 6.9 cents per acre, 6.9 cents per acre for Michigan, and 6.6 cents per acre for Minnesota. Subsequent salary adjustments because of increased cost of living, and price increases on materials and equipment have materially increased these cost estimates.

At the rate of 6.6 cents per acre, and with an estimated 19,665,000 acres of forested lands in this state subject to destructive fires and over which protection by the department is expected, the division of forestry should have available for its use for forest fire protection approximately $1,297,000 annually. It will be seen from this that notwithstanding encouraging increases in funds for fire prevention made by recent legislatures, that the goal of achieving adequate protection is still far away.

Basing action upon necessity, the division of forestry program includes the following activities:

Fire protection, without which no forest development could be justified.

Forest management, which in brief is the use of forest lands so that the greatest possible forest growth of the best adapted timber species is obtained.

Timber sales administration, gearing sales to management plans so that a continuous yield of timber will be maintained.

State nurseries producing forest tree planting stock to reforest areas where nature is unable to do the job because of improper use of lands.

Recreational development and use of forest lands so that the public may get the greatest recreational value out of the forest lands compatible with good forest management.

The promotion of auxiliary forests under the present laws and the study of the taxing of forest lands so that it may be economically possible for private owners to grow forests on forest lands.

These activities and other phases of forestry work are covered in more detail in the following reports prepared by the men in charge of the work.

FOREST FIRE CONTROL

A. E. PIMLEY, *In Charge*

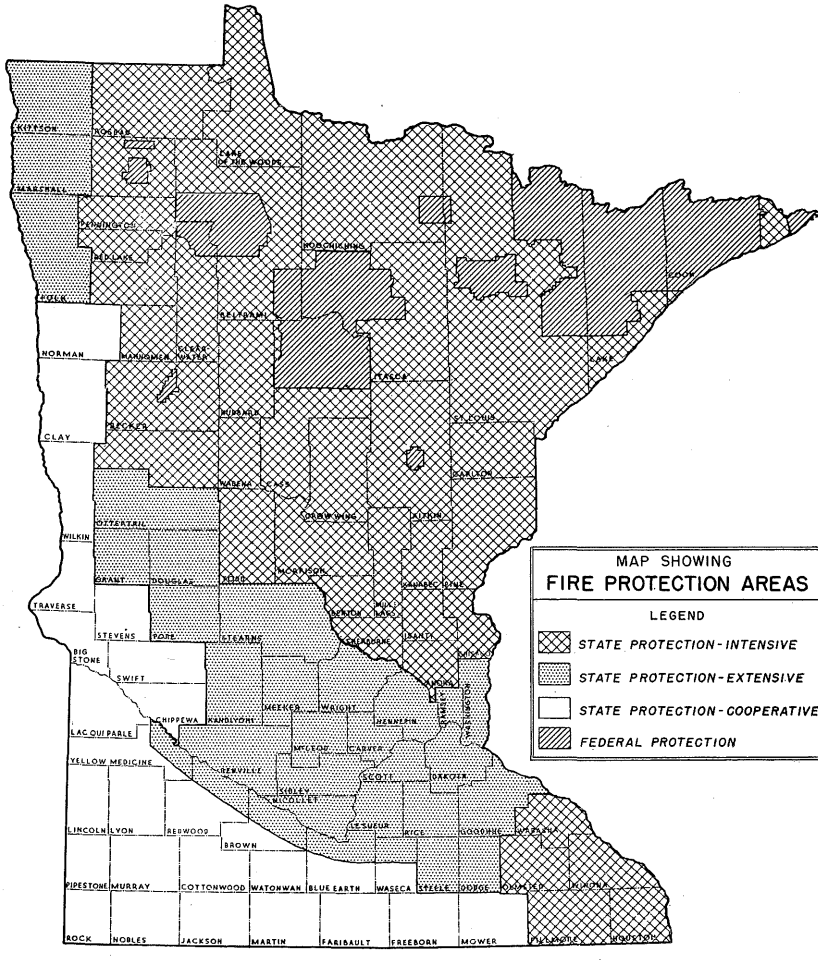
Fire Prevention Education

A vigorous and effective campaign of fire prevention education was carried on during the biennium by the division, stimulated and supported by the American Red Cross, the Keep Minnesota Green Committee, the Bureau of Information of the Department of Conservation, and other agencies. The increased public interest in the preservation of our forests against fires as reflected in the voluntary enthusiastic support given by public and private agencies augurs well for the future conservation of our forest resources. The distribution of literature, signs and posters and personal contacts made by the senior and junior chapters of the American Red Cross is proving a medium of education of immeasurable value.

The Keep Minnesota Green Committee sponsored and financed by a group of private corporations, organizations and individuals is performing an outstanding service in constantly keeping the public forest fire conscious. The work of this committee through the organization of ranger clubs in which young and old can participate and the distribution of badges, literature and merit awards is a stimulating and encouraging impetus to the efforts of the department in carrying on its far-flung forest fire prevention program.

This kind of participation by private organizations and individuals in the field of forest fire prevention education promises to be one of the most beneficial movements in the general conservation program which has yet been put forth in the state. Already many educators in the public schools recognize the benefit of fire prevention training among the younger generation and some of the schools and colleges are now including courses on the subject in their curricula.

The Bureau of Information of the Department of Conservation too has been very cooperative and active in spreading the gospel of fire prevention at public meetings extending to all sections of the state.



Map Showing Fire Protection Areas

Fire Protection Cooperation

It is gratifying to note that many of the larger lumber, mining and other companies in the state are now taking a more active interest in fire prevention than heretofore. One such company has set up a special fire control organization administered by a trained forester. Fire fighting equipment consisting of specially equipped trucks, tractors, power pumpers, trailers, water hauling equipment and a complement of small tools has been provided and is being held in readiness for immediate use during the fire season. The personnel of the company camps, as well as the field executives, are also alerted and held as stand-by reserves during hazardous periods. The administrative staff is participating in the regular state fire control

training program and is conducting special training meetings for the company employees.

This organization in cooperating with the division is doing exceptionally fine work and it is hoped that other companies and organizations operating within the protection zone will adopt similar plans.

Aircraft

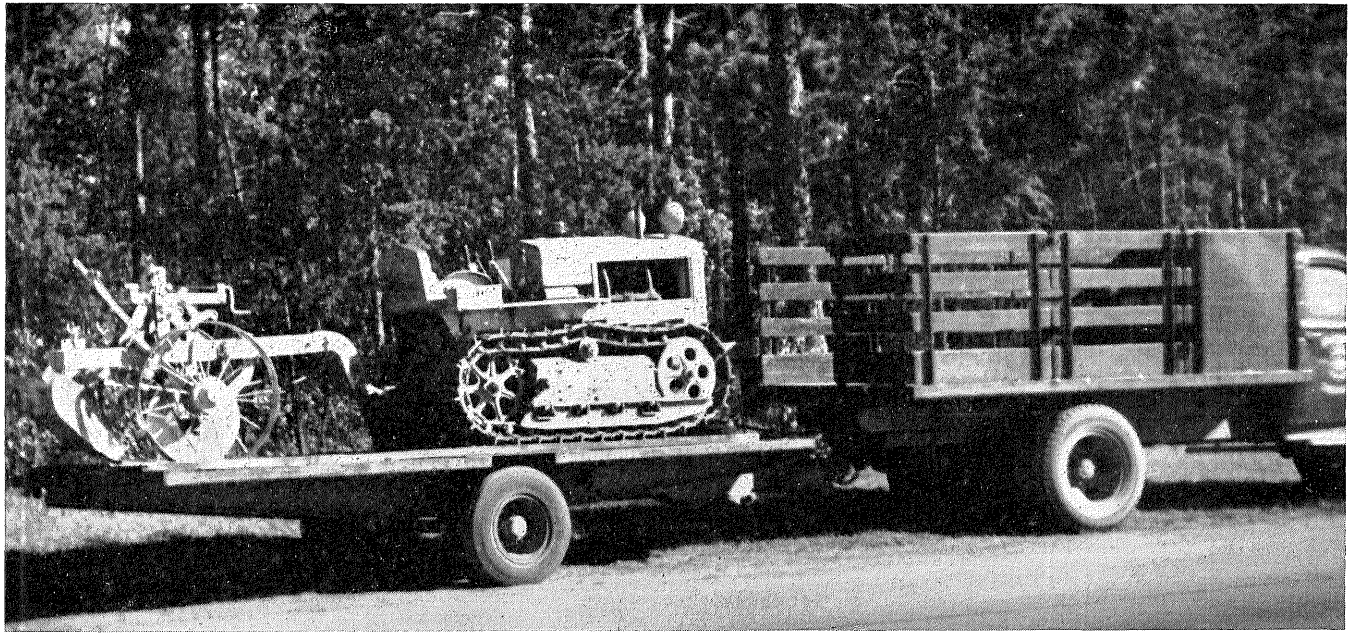
The Civil Air Patrol has been continued and expanded since the war and the commanding officer has assured the division the fullest cooperation of the state wing in all fire control activities. The members, many of whom own their planes, are well distributed over the state, and thus make it possible to procure quick service when it is required.

Several army training planes and an army liaison officer have been assigned to the unit. At present the planes are of the land type but it is proposed to equip some of them with pontoons for use in the more isolated lake regions. Some especially effective fire prevention work was done recently by members of this organization by dropping from the planes over fires, even those set under permit, fire prevention slogans to warn and advise anyone nearby. This way of emphasizing fire hazard in the forest gained rapid publicity throughout the community and its psychological effect upon the people proved generally to be very beneficial.

Arrangements have been made with many private aircraft owners for aerial service during emergency periods. Written agreements have been entered into with owners of 40 planes under which their planes will become available on a rental basis when needed. In addition the division of game and fish has two planes which are available for fire service during emergencies.

The radio stations in the state and several in adjoining states have been exceptionally cooperative in broadcasting fire prevention warnings and in keeping the forest fire menace before the public. Each year the division of forestry furnishes each of these stations, the announcers, and special commentators with a booklet of suggestions for station announcements urging care against starting fires. They are in the form of short vivid appeals in a wide enough variety to cover all of the seasons of the year and attract the attention of land clearers, meadow burners, hunters, fishermen, vacationists, berry pickers, autoists, and others whose presence in the forests have much to do with the incidence of fires.

Some progress was made during the biennium in extending fire protection to the southeastern counties through the organization of volunteer assistance units of the National Guard, game wardens, the Soil Conservation Service, the University extension service, farm forestry organizations, sportsmen's clubs, civic organizations, and interested individuals. Fire fighting equipment to supplement that of local soil conservation leaders was distributed within available limits in this territory. Equipment intended for use in Winona, Houston and Wabasha counties is now housed in the Winona National Guard armory.



Fire fighting squad unit, consisting of 2-ton LWB truck, power take-off pump, light weight portable pumper, 300-gal. water tank, 5-ton trailer, tractor, plow, portable tool boxes, 8 pump tanks, first aid kit, and emergency rations for 25 men.

All of southern Minnesota is now included in a state-wide farm forestry program supervised by trained forestry technicians who aid the smaller forest land owners in making small forest farms a contributing factor in increasing production of much needed forest products. It is hoped this service may be expanded to include full time employees who can devote the entire time to fire protection.

Personnel Training

The fire control training program has been continued during the biennium and plans have been made to extend it to the cooperative groups. Training sessions are conducted at each of the area headquarters for all of the regular field personnel and many of the seasonal men. One-day training courses are conducted at least once each season at most of the area headquarters for the benefit of the township fire wardens, keymen, and special cooperators. One or more general meetings, mainly for the benefit of the area supervisors, their assistants and the divisional administrative staff, are held each season where planning, administrative and advanced subjects in fire control management are discussed. Field demonstrations are held from time to time where instructions are given in the proper use, maintenance and operation of the various types of mechanical and heavy fire fighting equipment.

A general correspondence course in fire protection is made available to all employees of the division including cooperators. To date 160 have enrolled in the course and many have already completed it. An advanced course in fire control will be made available to regular employees within the next year and an elementary course covering fire prevention and suppression has been prepared for the volunteer groups, the township fire wardens and keymen.

First aid and safety courses, both regular and advanced, have been given to a selected group of the rangers by the American Red Cross. Those completing the advanced course have been assigned to the training of others of the division in their respective areas. Many of the regular force have completed this training and the remainder are expected to take it within the next year.

Future plans contemplate an elementary first aid training program within each locality in which fire protection men are located, to be conducted by forest rangers in cooperation with the American Red Cross and other safety agencies to which all interested individuals are eligible.

The 1946 Fire Season

The 1946 fire season started on March 24 with four fires on which control action was required, increasing to a total of 158 by the end of the month. With the exception of 1938, when 256 fires occurred during March, this was the greatest number for that month on record. All areas reported fires except Cambridge, Warroad, Baudette and Hovland. The last fire of that season burned on November 18 in the Moose Lake area.

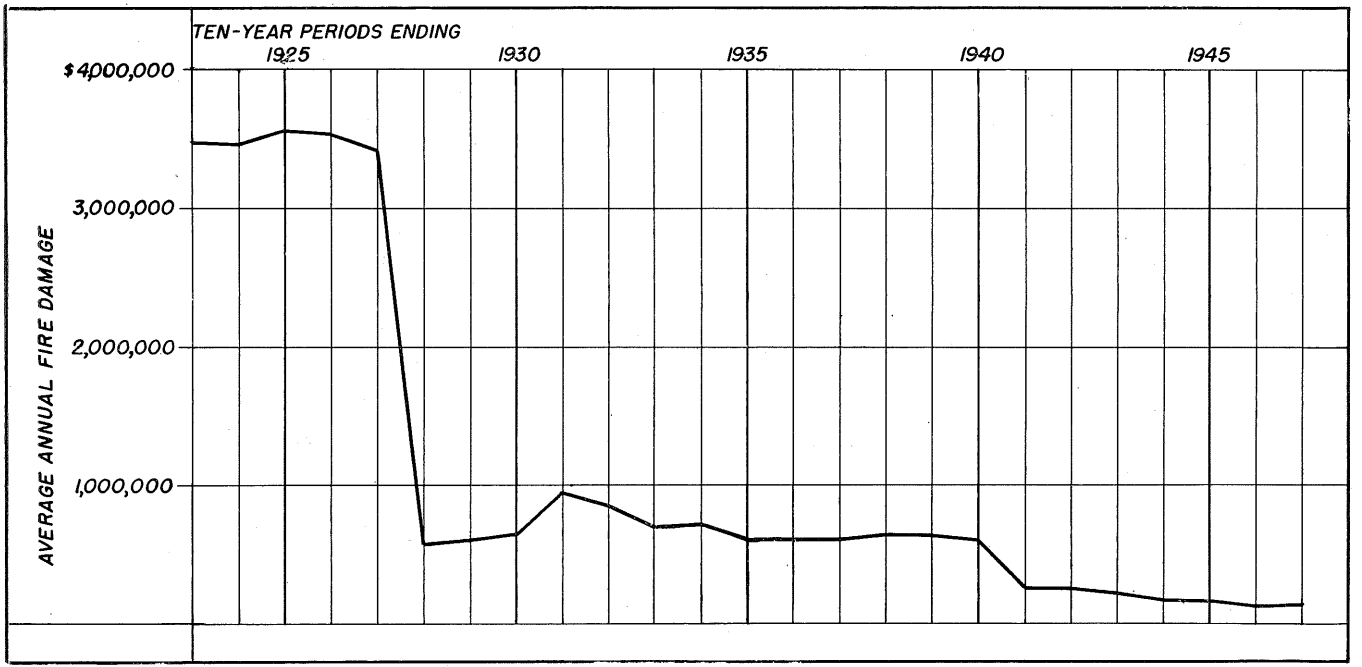


Figure 2

Forest Fire Damage
Ten-Year Averages 1914-1947

The first fall frosts occurred on August 29 in both the Brainerd and Cloquet areas but were not heavy enough to kill much vegetation. On September 1 and 2, below freezing temperatures were recorded over almost the entire protection area with heavy killing frost in the Warroad and Blackduck districts. By the last of September most of the vegetation was killed over the entire northern half of the state.

The estimated damage for the year, mainly to timber reproduction, wildlife and recreation, exceeded $165,000, or an average of $126 per fire.

Of the total of more than 92,000 acres burned over, 50 per cent was non-forest land consisting mainly of open peat bog, the area burned over by each fire averaging 70 acres.

The 1947 Fire Season

From March 28 to November 1, 1947, 935 forest fires required control action. The first one occurred on March 28, but in spite of liberal rainfall during April, 119 fires were reported by May 1. Deficient precipitation and high temperatures and winds during May increased fires to a total of 374 during that month, the greatest number reported for any other month of the year.

Normal conditions prevailed during the months of June, July, August and the first half of September. The unevenly distributed rainfall which fell during the latter part of September left drought conditions in the south central areas while the northern and western areas were completely safe from fire. While normally the fire season ends in Minnesota early in October, the September drought coupled with abnormally high temperatures and winds extended hazardous conditions which became quite acute by the middle of October. On the 16th and 17th wind velocities of from 21 to 30 miles an hour and temperatures up to 80° were reported in the Moose Lake, Brainerd and Hill City areas. On these days 24 fires, several of them reaching large proportions before being brought under control, started in these three areas, burning over a total of 31,000 acres with an estimated damage of approximately $86,000. These fires, all starting within two days, burned over 51 per cent of the total area and caused 55 per cent of the total damage for that year.

A total area of 60,013 acres was burned over during the 1947 fire season, causing an estimated damage of $156,306. Of the total area burned over 44 per cent was productive forest land, 20.3 per cent denuded forest land and 35.7 per cent was non-forest land. Over 60 per cent of the denuded and non-forest areas were open peat bog much of which is unsuited for the growing of commercial timber.

The 1948 Spring Fire Season

Fire conditions during March and the first two weeks in April of 1948 were quite favorable. No fires occurred in March and only 18 were reported during the first half of April. Drought conditions during the last half of

April, however, caused another upward surge of fires. In the southern and central districts of Cambridge, Moose Lake, Park Rapids and Bemidji, 140 fires were reported during the last half of April, burning over approximately 9,000 acres.

Deficient rainfall unevenly distributed made the month of May the driest month since 1934. Most of the stations in the southern portion of the extensively protected area recorded less than one-half inch of rain for the entire month. All districts had fires during the month but of the 446 reported, 381 occurred in the south half of the fire zone.

Normally green vegetation develops rapidly in the spring so that by the last of May the fire hazard has been largely removed until the midsummer and autumn months. Due to the shortage of moisture in May, 1948, however, followed by abnormal drought conditions in June, the hazard continued to increase in severity until after the middle of June.

From the middle of April until the middle of June, 715 fires occurred which required control. They burned over approximately 30,000 acres, of which, fortunately, a large portion was open bog and grass land, thus resulting in a comparatively light timber loss.

Tables 1 to 9 show statistics on forest fires by causes, number of fires, areas burned over, estimated damage, types, origin and classifications for the years and under the conditions indicated in each.

TABLE 1

Number of Fires Per Year and Origin

Origin	1942	1943	1944	1945	1946	1947
Lightning	2	3	1	1	4	13
Railroads	52	176	68	397	212	232
Campfires	29	22	12	22	44	30
Smokers	131	179	109	141	388	273
Land Clearing	82	76	63	76	146	93
Incendiary	37	11	34	19	36	16
Lumbering	12	14	8	6	21	12
Meadow Burning	164	178	192	141	315	149
Miscellaneous	89	94	55	66	144	117
TOTAL	598	753	542	869	1,310	935

TABLE 2

Number of Fires Per Year and Causes

Causes	1942	1943	1944	1945	1946	1947
Farmers	253	258	238	202	465	262
Hunters	54	65	52	39	80	83
Fishermen	32	19	10	30	86	56
Berry Pickers	0	5	8	3	25	36
Work Crews	17	35	16	14	52	35
Trappers	0	0	0	0	.....	.....
Travelers	61	69	46	87	197	126
Miscellaneous	148	148	110	106	204	129
Locomotives	33	154	62	388	201	208
Unknown	0	0	0	0	.....	.....
TOTAL	598	753	542	869	1,310	935

TABLE 3

Area Burned Over and Origin

Origin	1942	1943	1944	1945	1946	1947
Lightning	0	0	0	0	1	25
Railroads	302	1,403	1,002	1,503	1,408	2,780
Campers	3,078	689	126	474	1,059	1,575
Smokers	2,854	14,445	4,678	2,463	16,599	7,614
Land Clearing	6,006	10,026	6,187	3,897	20,404	11,161
Incendiary	2,703	363	2,036	2,656	2,602	2,734
Lumbering	220	324	132	86	346	217
Meadow Burning	13,329	18,106	22,541	9,303	44,412	28,480
Miscellaneous	5,902	2,350	4,910	1,891	5,235	5,428
TOTAL	34,394	47,706	41,612	22,273	92,066	60,014

TABLE 4

Forest Fire Damage

Year	Merchantable Timber	Young Growth	Soil and Watershed	Wild Life and Recreation	Miscellaneous Damage	Total Damage
1942	$ 1,679	$28,839	$11,571	$23,419	$ 9,477	$74,985
1943	2,213	25,160	13,368	25,052	13,318	79,111
1944	1,646	25,924	12,918	24,339	8,918	73,745
1945	226	9,583	6,210	13,970	9,112	39,101
1946	4,637	66,983	17,649	44,501	31,856	165,626
1947	11,393	80,659	12,177	39,337	12,740	156,306

TABLE 5

Forest Fire Damage by 10 Year Periods

Periods	Damage
1933-1942	$2,620,353.00
1934-1943	2,150,818.00
1935-1944	1,775,451.00
1936-1945	1,779,093.00
1937-1946	1,265,362.00
1938-1947	1,395,342.00

TABLE 6

Number Fires by Months

Month	1942	1943	1944	1945	1946	1947
March	2	.....	.....	36	176	1
April	448	255	372	82	647	119
May	29	133	49	499	230	374
June	8	6	10	109	36	70
July	8	39	12	48	34	98
August	13	14	5	23	84	84
September	1	79	2	8	54	29
October	76	223	84	62	32	160
November	13	4	8	2	17	.....
TOTAL	598	753	542	869	1,310	935

TABLE 7

Origin and Damage from Fires Per Year

Origin	Percent of Total—6 Yr. Period	1942	1943	1944	1945	1946	1947
Lightning	0.1%	$ 1	$ 1	$ 150	$ 0	$ 1	$ 412
Railroads	3.6%	602	6,678	2,133	3,494	3,268	5,244
Campfires	3.4%	9,299	778	679	3,620	2,114	3,364
Smokers	15.3%	5,150	16,258	9,681	3,522	32,956	22,516
Land Clearing	17.3%	14,650	16,847	12,144	5,498	19,294	31,970
Incendiary	4.8%	8,118	673	6,287	1,243	7,282	4,783
Lumbering	0.5%	931	1,722	315	147	1,388	1,150
Meadow Burning	39.3%	16,816	29,391	33,712	11,801	70,656	68,386
Miscellaneous	15.7%	19,418	6,763	8,644	9,776	28,667	18,481
TOTAL		$74,985	$79,111	$73,745	$39,101	$165,626	$156,306

TABLE 8

Type of Area in Acres Burned Over

Year	Merchantable Timber Land	Reproduction	Denuded Forest Land	Non-Forest Land	Total
1942	661	10,700	11,696	11,337	34,394
1943	837	10,832	13,376	22,661	47,706
1944	282	10,551	13,029	17,750	41,612
1945	176	4,445	6,271	11,381	22,273
1946	1,660	24,030	17,519	48,857	92,066
1947	1,817	24,624	12,148	21,425	60,014
Percent of Total	1.8%	28.6%	24.8%	44.8%	

TABLE 9

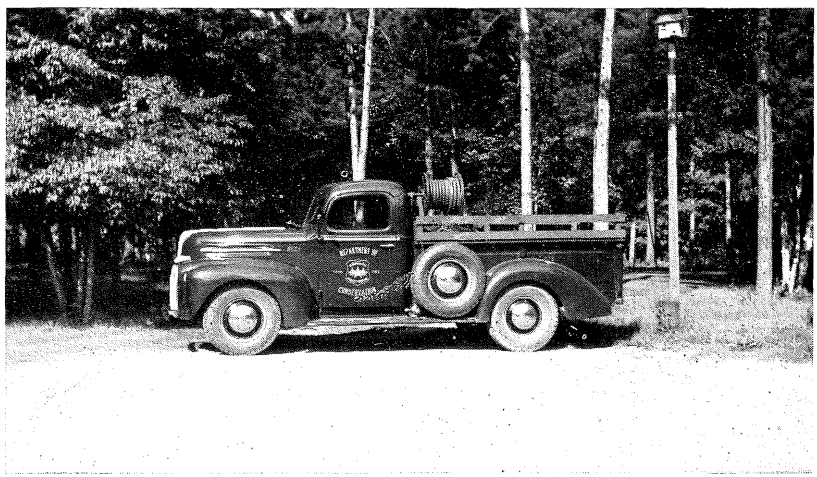
Classification of Fires by Size

Year	A Under ¼ Acre	B ¼ Acre to 10 Acres	C 11 Acres to 100 Acres	D 101 Acres to 1,000 Acres	E Over 1,000 Acres
1942	56	229	232	77	4
1943	142	293	251	62	5
1944	58	177	207	99	1
1945	314	305	197	52	1
1946	201	513	429	156	11
1947	235	382	252	58	8
Percent of Total	20.1%	37.9%	31.3%	10.1%	0.6%

Fire Fighting Equipment

Heavy power fire fighting equipment has been developed to a point where its use has become absolutely essential in suppressing fires. Its use not only reduces the area burned over and damage and cost of suppression, but eliminates to a large extent large crews of men which are usually difficult to recruit on short notice in many localities.

A number of new heavy equipment units were placed in service during the biennium but there is still urgent need for more. All of the division's heavy power and other fire fighting machinery was used but at times it became necessary to hire privately owned units to cope with the fires. Difficulties of transporting loaned or leased heavy type machines, finding opera-



One-ton initial attack truck unit equipped with power-takeoff pumper, 100-gal. water tank, 8 5-gallon back pack pump tanks, 8 shovels, 2 Pulaski tools, 2 D.B. axes, emergency rations for 10 men, backfire torch and first aid kit.

tors to man them, and fuel and parts to keep machinery in operation on short notice, result in delays in suppression work which may prove costly. Orderly and efficient suppression work can best be done by the division's own carefully selected equipment strategically distributed over the protection area.

Two hundred eighty miles of tractor fire trenches were constructed during the years 1946 and 1947 in the suppression of 280 fires as compared with 37 miles of hand trenches involving 182 fires.

Considerable experimentation has been carried on in the development of a suitable heavy duty power plow for general fire line use. Several satisfactory types have been developed but the one best suited for Minnesota conditions is a two-way "middle buster" implement and has been adopted by the division as standard equipment. Eighteen new units of this type have been acquired during the past two years and more will be purchased as funds permit.

Table 10 is a list of major equipment units in service at the present time.

TABLE 10

Fire Fighting Equipment

Major Items

Equipment Item	Total Units in Service
Truck units ¼ ton to 1 ton	80
Truck units 1½ ton to 2½ ton	66
Administrative automobiles	9
Trailers 5-10 ton	19
Trailers, utility	60
Fire plows, heavy duty	55

TABLE 10—Continued

Equipment Item	Total Units in Service
Fire plows, medium	36
Mechanical pump units	224
Power take-off pump assembly	25
Fan belt pumpers	36
Firebreak maintenance graders	20
Tractors—all types	44
10-man fire fighting cooking kits	24
25-man fire fighting cooking kits	25
50-man fire fighting cooking kits	2
100-man fire fighting cooking kits	3
Fire fighting camp blankets	4,501
Fire fighting camp tents	252
Fire hose, all types	140,989 ft.
Back pack pump tanks	4,241
Fire axes	4,920
Fire shovels	7,041
Pulaski fire tools	185
Radio units	25
Fire finders	6
Fire patrol launches	2
Fire patrol power boats	23
Fire patrol outboard motors	27
Water tanks, 50-100 gallon	232
Water tanks, 200-300 gallon	50

Proposed State-wide Fire Control

The following is a brief resume of proposals and estimates of expenditures designed to provide reasonable and justifiable fire protection for Minnesota. Estimates of per acre protection costs are based on a mean between pre-war and present high prices of labor, material and equipment, the items to be acquired and the costs to be financed over a period of five years.

For administrative and fiscal considerations, the protection areas have been divided into the following three classes:

First, an intensively protected area where the hazard, risk and damages are high and which requires the maximum of fire control facilities.

Second, the extensively protected area where the hazard and risk are somewhat less than in the first class but where values of property subject to damage are considered high.

Third, the cooperatively protected zone comprising the more or less highly developed farming areas and where the hazards and risk are low during normal times but where the potential damage from fire to game, game cover, watershed, recreation and permanent improvements is a major problem during dry spells or when abnormal conditions create high hazard periods.

The total acreage considered in the plan does not include water areas, crop lands or the national forests and Indian reservations where protection is provided by the federal government.

At the present time the area under protection, exclusive of farm land, embraces approximately 20 million acres, of which about 17 million acres are under intensive protection and the remainder under extensive control. Much of this is in the northern half of the state. A recent survey, however, shows that there are more than 10 million additional acres in the southern half of the state which would be greatly benefited by receiving some degree of protection, and should be placed in the extensive and cooperative classes thus making a total of approximately 30 million acres.

The funds required to carry out this proposed program would be expended primarily on additional equipment and facilities with a small amount for increased personnel.

Recent estimates on the cost of adequate fire protection, from which the federal fire protection allotments from Clarke-McNary funds are made to Minnesota, show that the cost per acre for reasonable protection of forest lands within intensively protected areas approximate 7.4 cents per acre, and for that under extensive control 1.9 cents per acre, or an average for the two classes of 6.6 cents per acre.

Comparing these estimates of needs with the funds actually made available for fire protection in Minnesota at present, we find that during the past five years the average annual per acre expenditure for both prevention and suppression averaged approximately 1.4 cents per acre.

Very few changes in the present organization will be necessary to do the proposed job and very limited additional permanent improvement will be required. It is proposed that the funds to be provided for the expanded program shall be distributed between the three protection areas in proportion to actual need. The greatest amount would be used in the intensively protected area to build up the division's equipment and to increase the trained personnel, the remainder to be thinly spread over the newly added territory.

The plans will be carefully reviewed and studied during the next biennium and a detailed report with listing of equipment, estimates of cost, time and plan of execution, suggestions for financing over a period of years and statistics to justify the program, be presented to the legislature of 1949. It is believed that after the proposed plan has been fully developed that the fire protection problem will resolve itself largely into one of maintenance and replacement of equipment with little or no material change in personnel.

Table 11 is a resume of losses of human lives and money from forest fires and funds expended on suppression for the years 1911 to 1948.

TABLE 11

MINNESOTA FOREST FIRES
1911-1948

Caused the loss of 447 human lives.
Destroyed timber, buildings, crops and permanent improvements, the value of which is estimated at..$44,084,305[1]
Cost of prevention and suppression..... 11,240,441

Amount paid for the relief of fire sufferers	2,463,969[2]	
Total		$57,788,715
Annual average for 37 years		$ 1,561,857
Amount spent for prevention, before the fires started	$8,510,443[3]	
Estimated damage, cost of suppression and the amount paid in relief, after the fires started	49,278,272	

[1]The major portion of the damage shown relates only to timber, hay, buildings, fences and other improvements. It does not take into account the tremendous losses caused each year to soil, game and game cover, recreational areas, watersheds, esthetic and economic values, to say nothing of the loss of human life.

[2]Includes only the amount of funds paid by the state for direct relief of the fire sufferers and does not include the many millions of dollars paid by the federal government, or the numerous contributions made by organizations and private individuals.

[3]Research and past records on the subject show that a reasonable amount of funds spent for **prevention** before the fires start greatly reduces the damage and the amount required for fire control. Of the losses to the state during the past 37 years, in both property damage and in money expended, only 14.7 per cent of the total was actually used for the prevention of fires.

Lookout tower station in winter.

Lumbering Operations

Although fire hazard may be at a minimum, forest personnel is kept busy winter as well as summer. One of the activities which requires much time and attention is the supervision of logging operations including enforcement of trespass and cutting laws. The law provides that before a commercial logging operation may begin a report must be submitted to the director of the division of forestry so as to enable him to properly locate slashings and to assure that they are properly disposed of and thus eliminate fire hazards. During the period from July 1, 1946, to June 30, 1948, 9,346 such reports were received, covering 19,721 parcels of land, aggregating a total of 788,840 acres.

RAILWAY FIRE PREVENTION

WM. M. BYRNE, *In Charge*

The experiences inherent in the pioneering work of those who lived and operated within our forests, have made them conscious of the forest fire menace. Individuals and corporations have slowly but progressively increased public support for fire prevention and the development of equipment for the detection and suppression of forest fires. Thirty-five years ago this interest was practically non-existent.

In order to create power, locomotives constantly have to carry fuel and fire, creating fire risks peculiar to railroad operation. Research has been carried on for years and is still being carried on, aimed at perfecting devices that will eliminate the chance of locomotives setting fires. While others may "keep their matches at home" in times of high hazard, the locomotive with its fire box of burning coal and its smoke stack emitting sparks of necessity must operate during safe and hazardous periods alike. While no method has been devised to entirely prevent the emission of sparks by coal-burning locomotives, railroad operators generally are constantly on the alert for improvement in spark arresters and other fire arresting devices for their equipment.

It is estimated that a locomotive starts one fire on an average for each 156,700 miles of travel. Good as this record may appear, it is still a matter of concern when we are reminded that there are hundreds of locomotives constantly in operation. Locomotives of one division of one of the larger railroads alone traveled an estimated one and three-quarter million miles during the fire season of 1947. It is to be seen therefore that, viewed in the aggregate, fires set by railroads are still of major concern.

Another fire hazard peculiar to railroad operation and next in importance to fires caused by locomotives, is the burning over of rights of way and the disposal by burning of old ties. This hazard is being greatly lessened by the clearing of rights of way of stumps, logs, and lesser debris, the increase in area of cultivated fields adjacent to rights of way, and the

construction of hundreds of miles of highways paralleling the railways. Furthermore, increased use of treated ties has reduced to a minimum yearly tie renewal, and the burning of old ties is no longer a serious fire hazard.

Railroad companies are required by law to extinguish fires set by them as well as to make a written report to the division of forestry of fires found on or adjacent to their rights of way whether set by them or started otherwise. Furthermore, the statutes prescribe that a patrol must follow trains during the high hazard periods. Due to the increased speed of trains, freight trains now being operated practically on passenger train schedule, the efficiency of speeder patrol following after trains has been lessened. An increase in the number of patrols or patrol by the section crews can be made to overcome the difficulty.

TABLE 12

Cause of Fires and Area Burned Over—All Railways

	Locomotives		Debris Burning		Other Ry. Fires	
	No.	Area	No.	Area	No.	Area
2nd 6 mo. 1946.....	51	65½	1	3	0	0
1st 6 mo. 1947.....	97	579¼	7	52¾	1	2
Total	148	644¾	8	55¾	1	2
2nd 6 mo. 1947.....	126	1771¼	10	80¼	6	10½
1st 6 mo. 1948.....	330	1064¾	1	620	19	56
Total	456	2836	11	700¼	25	66½
Sub Total.....	604	3480¾	19	756	26	68½

Grand Total: Number of Fires: 649; Area Burned Over: 4305¼ acres

Detection and Origin

	Ry. Patrol	Sec. Men	Other Ry. Employees	MFS U. S.	Outsiders	Burned Out	Locomotives A	B	C	Burning Debris A	B	C	Other Ry. Fires A	B	C
2nd 6 Mo. 1946	14	9	6	10	13	0	32	18	1	0	1	0	0	0	0
1st 6 Mo. 1947	32	25	22	16	9	1	54	31	12	2	4	1	0	1	0
Total	46	34	28	26	22	1	86	49	13	2	5	1	0	1	0
2nd 6 Mo. 1947	30	26	19	24	36	7	72	40	14	4	4	2	3	3	0
1st 6 Mo. 1948	144	53	43	70	34	6	230	86	14	0	0	1	7	11	1
Total	174	79	62	94	70	13	302	126	28	4	4	3	10	14	1
Sub Total.....	220	113	90	120	92	14	388	175	41	6	9	4	10	15	1
Grand Total:			649					604			19			26	

TIMBER ADMINISTRATION

J. C. GANNAWAY, *In Charge*

The State of Minnesota is by far the largest owner of timber in the state. Because of the critical part that timber products play in the state's economy, the efficient management of this natural resource is of the utmost importance and a heavy responsibility on those charged with its administration. It affects directly all of the state's wood working industries whose con-

tinued existence depends on an uninterrupted supply of material from our forests. Any material curtailment of supplies would result in serious unemployment and economic stagnation in a large section of the state where timber and the manufacture of timber products is a chief source of income. Furthermore, the income which the state derives from the sale of its timber makes up a considerable portion of the permanent trust funds, the income from which goes to the support of public education. It follows that any condition or circumstance that would decrease or otherwise depreciate this source of income, would be statewide in its effects.

During the war years there was a heavy drain on the timber resources of the state. This situation could not be avoided as the demand for war production had to be met. It was the opinion of many in the industry that the demand for forest products would decline at the termination of the war. The wartime suspension of home building and other kinds of construction which normally consume our timber products, however, built up a vast backlog of demands which has to be satisfied and which still is a heavy drain on the products of our forests.

Notwithstanding the fact that Minnesota is the largest holder of high grade pulpwood stumpage in the Lake States region, the state cannot produce sufficient spruce and balsam to supply the current demand for pulpwood without endangering its remaining stands. Obviously, if local paper mills and other wood fiber using industries are to be kept operating into the future, a balance between sales and cutting programs and timber growth must be established and maintained. Because of the present export limitations imposed by the Canadian government on pulpwood, there is an especially heavy pressure on Minnesota timber by mill operators who formerly bought Canadian pulpwood and who must now secure it elsewhere.

The most significant deterent to the placing of our forests on a sustaining yield basis has been the lack of a reliable inventory of our forest resources. During the past two years considerable progress has been made in this direction, and some of the forests which have a large percentage of state land and a relatively large supply of merchantable timber have been inventoried and plans for their management have been developed. There is still much work to be done to complete this inventory for all the state forests. A dependable supply of timber to sustain the state's wood using industries will rest largely on an authentic knowledge of what we really have and of the capacity of our state forests to produce a sustained output.

The division is constantly experimenting with and studying methods to control and regulate the cutting of state owned timber. To be effective, a program must prescribe the cutting of mature, over-mature and defective trees first, and the introduction of sound silvicultural practices for the care and rapid growth of remaining immature trees to the end that volume of growth be made to increase as rapidly as possible. Reproduction should be well on the way before all of the mature crop has been removed. Clear-cutting is no longer practiced on any state owned lands where it can possibly be avoided. Where conditions make clear-cutting necessary, natural

reproduction usually follows. In some cases, however, artificial planting is done.

In addition to studies of the best methods to follow in the selection of trees to be cut, considerable progress has been made in encouraging a more complete utilization of all classes of timber cut. This is especially true in the high grade fiber producing spruce and balsam. All present state contracts specify that spruce and balsam must be utilized to a 3-inch diameter top. This compares with former specifications which invariably required that all spruce have not less than a 4-inch diameter top. This use of the trees to a smaller section will increase the yield by about 10 per cent. Studies on still more complete utilization of trees will be conducted to determine whether cutting of timber to a still smaller diameter top has or can be made of commercial value in the manufacture of paper or other products.

Timber sold from state owned lands has enhanced state funds by millions of dollars, most of which has been credited to the state trust funds that go to the support of public education. Present sales yield annually more than half a million dollars. The question whether this or any other rate of cutting and selling of timber products from state owned lands is the rate that timber growth can sustain into the future, can only be authoritatively answered through continuous intensified forest management.

The timber sales division has at present only 13 full time appraisers, whose duties are largely governed by statute. These men cruise the timber to be offered for sale, supervise the cutting and utilization of products harvested under upwards of 1,300 timber permits, and check timber scales before the timber is removed from the land from which it is cut. They enforce timber trespass laws in an area aggregating two million acres. Without the aid of the forest rangers who assist the appraisers in periods of low fire hazard when the former can be spared from fire prevention or fire suppression work, it would be impossible for the timber appraisers to perform the work expected of them. To complicate matters, the salaries paid by the state to the best trained and most valuable employees do not compare with salaries paid by industry and the federal government, with the result that some of the most experienced employees have left for more remunerative employment. Present appropriations are inadequate to maintain an organization for the most efficient administration of the state's timber sales and cutting activities.

For a summary of timber cut through auction sales, value of timber cut by trespassers, and value of timber sold at private sales, see Tables 13, 14, and 15, respectively.

Table 13

TIMBER CUT UNDER AUCTION SALE TIMBER PERMITS
FISCAL YEARS 1947 AND 1948

SPECIES	FEET		CORDS		TIES		POLES		POSTS		TREES		VALUE	
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948
Pine, White and Norway	6,520,440	3,253,030											$90,997.98	$39,059.32
Jack Pine	2,795,534	2,002,015	12,867	23,909									32,432.61	53,184.76
Spruce	1,958,990	712,270	64,277	64,971									214,342.71	190,262.29
Tamarack	180,572	197,640	190	116	5,960	8,745							2,101.75	2,532.80
Tamarack Mining Timber	*89,616	*78,754											224.04	196.88
Poplar	4,008,320	2,835,925	6,182	6,279									23,694.83	18,698.52
Balsam	668,750	169,020	14,209	14,996									24,235.54	24,660.33
Birch	97,600	46,850			15,151	15,378							3,375.93	3,932.40
Basswood	36,510	14,580											296.58	47.80
Cedar					24,341	22,524	126,979	142,280	391,034	216,439			62,289.26	89,939.61
Oak	11,980	980											65.25	6.21
Mixed Timber	53,990	34,970	381	2	1,026	521							1,007.59	287.56
Cedar Lagging			562	420									628.63	311.42
Mixed Bolts			4,908	4,239									8,808.84	9,179.60
Fuelwood			1,341	852									490.19	335.66
Christmas Trees											606,027	577,285	12,159.43	12,673.24
Totals	16,332,686	9,267,280	104,917	115,784	46,478	47,168	126,979	142,280	391,034	216,439	606,027	577,285	$477,151.16	$445,308.40
													Extension Interest....	20,813.49	23,752.60
													Penalty Interest.....	128.56	1,316.60
														$498,093.21	$470,377.60

*Lineal Feet.

Table 14

TIMBER CUT IN TRESPASS ON STATE LANDS
FISCAL YEARS 1947 AND 1948

SPECIES	FEET		CORDS		TIES		POLES		POSTS		TREES		VALUE	
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948
Pine, White and Norway	51,402	9,785											$765.76	$142.90
Jack Pine	108,955	7,650	130	278									2,440.39	877.46
Spruce	7,940	5,900	288	1,020									2,313.62	7,101.22
Tamarack	530		8	13	18	51							34.97	64.11
Jack and Norway Piling		*2,389												192.49
Poplar	36,960	4,140	61	58									695.26	176.31
Balsam	3,120	1,520	65	152									275.37	824.49
Birch	6,790				44	22							87.59	6.30
Basswood	9,980	2,010											61.69	72.24
Cedar					94	409	107	590	2,678	3,584			329.24	1,062.13
Mixed Timber	13,814	120	41	14	22								366.60	83.82
Mixed Bolts			9	41									18.44	174.47
Fuelwood			121	150									196.61	168.16
Christmas Trees											241	707	13.27	92.03
Totals	239,491	31,125	723	1,726	178	482	107	590	2,678	3,584	241	707	$7,598.81	$11,038.13
												Penalty	2,844.60	3,517.31
													$10,443.41	$14,555.44

*Lineal Feet.

Table 15

TIMBER SOLD AT PRIVATE SALE
LAWS 1939, CHAPTER 352
FISCAL YEARS 1947 AND 1948

SPECIES	FEET		CORDS		TIES		POLES		POSTS		TREES		VALUE	
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948
Pine, White and Norway	3,159,808	872,920											$30,817.61	$9,275.14
Jack Pine	2,271,725	1,063,035	5,273	3,133									24,948.56	14,203.52
Spruce	801,530	219,510	10,168	17,818									35,508.39	55,132.20
Tamarack	160,440	144,360		999	1,240	1,827							1,075.27	3,022.06
Tamarack Mining Timber	*243,684	*160,066											620.38	607.08
Poplar	2,650,963	2,859,943	8,951	10,515									19,787.39	18,896.16
Balsam	568,358	277,760	7,274	8,422									16,360.00	20,160.14
Birch	181,730	108,080			4,148	3,458							1,510.78	1,087.71
Basswood	151,860	106,260											742.53	646.43
Cedar					2,211	3,219	27,651	13,449	129,730	63,631			12,350.36	5,507.28
Oak	55,460	22,480											584.04	161.31
Mixed Timber	594,471	321,520	216	76	1,800	1,599							2,584.04	1,404.94
Jack Pine and Cedar Lagging			298	132									170.19	106.45
Mixed Bolts			8,722	5,988									16,306.11	11,837.38
Fuelwood			12,144	5,947									6,267.69	2,736.90
Christmas Trees											206,820	258,280	4,140.40	5,241.20
Totals	10,596,345	5,995,868	53,046	53,030	9,399	10,103	27,651	13,449	129,730	63,631	206,820	258,280	$173,773.74	$150,025.90

*Lineal Feet.

FOREST MANAGEMENT

E. L. LAWSON, *In Charge*

Every business concern with goods to sell or manufacture takes at least an occasional inventory. A knowledge of the volumes and types of goods in stock will not only be a measure of the kind of goods for which there has been the greatest demand, but will also indicate what there is on hand for future sales.

What is true of business is equally true in the management of forest land. Accurately prepared and carefully followed management plans are essential to the operation of a forest property on a sustained yield.

Dependable bases from which to check annual cuts against annual growths and shifts in demands and uses cannot be established until we know where, how much, and what species forest properties will produce. The state and every industry depending on a constant supply of raw timber material are alike concerned with continuous, reliable, up to date data on the status of our timber resources.

The most acute timber supply problems have to do with the years immediately ahead rather than with the distant future. The danger of a shortage of spruce and pine is of particular concern to forest managers because of the abnormal pressure of industry for material to meet the demands of post-war efforts to take up the slack which accumulated during the war. This pressure for timber products, unless limited to the current productive capacity of forests, will cause depletion of growing stock from which future needs must be supplied. As inventories are completed and authentic knowledge is acquired on the type, volume, age and growth variables, the limitations within which consumption of our present forest resources must be fixed become more and more apparent. If we recognize what this means to our future plans for timber use, we can understand why it is of utmost importance to speed progress on the completion of management plans for the long time future.

The division of forestry manages approximately 4,100,000 acres of state owned forest lands. This acreage is scattered over 15 of the northeastern counties and comprises more than one-fifth of the total forest area of Minnesota. Within this area there have been selected and organized to date eight management blocks or units embracing a total of 2,280,918 acres of which the state owns 1,104,022 acres. See Table 16. Each of these blocks and the areas embraced in each were determined from a study of location, types and volume of timber, percentage of mature timber ready for cutting and other factors, which combine to make each block a practical management and operating unit. A plan of management applicable to each unit is being developed as inventories and other studies of its forest resources are being completed. These studies apply not only to the lands owned by the state but to all lands within the unit, including private, county and federal lands.

Black spruce selectively cut and utilized to a 2½" top diameter.

TABLE 16

Forest Management Blocks on Which Forest Surveys and Management Plans Have Been Completed

July 1, 1948

Management Block	Total Area Acres	State Land Acres	Percentage of State Lands
Big Falls	367,071	280,788	76
Burntside	23,096	23,096	100
Black River	374,555	180,683	48
Savanna	203,218	98,968	49
Northwest Angle	80,000	9,915	12
Dentaybow	337,763	174,400	52
Pelican Lake	143,901	52,719	37
Craigville*	751,314	283,453	38
Total	2,280,918	1,104,022	48

*Completed in 1945.

As already indicated, the state is committed to a cutting schedule that will insure sustained yield on state lands capable of producing timber. Insofar as possible, all future timber harvests from state lands within management blocks will be based on allowable cuts as established in the work plans and will be kept in periodic balance by species. To date, however, forest surveys and management plans have been completed for not more than 27 per cent of the forest land area in state ownership. It is obvious that good management of the forest areas of the state, whether in private ownership or under the control of public agencies, cannot be attained until inventories

and management plans are completed for the entire area. This requires a permanent organization of foresters trained to conduct surveys and to prepare work plans for each management unit and administer timber cutting and other regulations. The division's present staff of foresters engaged in this type of work is inadequate to complete the necessary inventories and work plans within the period of time when such work should be accomplished. The legislature has never made any appropriations specifically earmarked for forest management. It is becoming increasingly apparent that appropriations for this work should be requested from the legislature.

Big Falls Experiment Forest

The Lake States Forest Experiment Station and the division of forestry have selected an area of state owned forest land in which to carry on joint experiments and demonstrations aimed at the management for greater use of coniferous swamp forests, particularly black spruce. The tract is located in the Koochiching state forest in the vicinity of Big Falls, and embraces an area of approximately 2,000 acres predominantly of black spruce swamp type. Research will be directed particularly towards management of spruce swamp lands as it relates to the utilization, regeneration and greater economic returns of coniferous swamp types. The Lake States Forest Experiment Station has assumed the responsibility for planning and conducting the experiments and keeping of the records. The division of forestry is to conduct field studies, and any timber yielded in the course of the project will be sold by the state the same as timber is sold from other state lands. Both agencies will jointly compile, analyze, publish and disseminate currently the results of their findings.

Acknowledgment is made of the valuable assistance rendered by the various federal forestry agencies operating within the state, the individuals and corporations who have contributed to the work of promoting forestry management plans and projects.

CHRISTMAS TREES

R. CLEMENT, *In Charge*

It is estimated that approximately three million Christmas trees were cut during each year of the biennium, yielding an annual revenue in excess of three million dollars to the agencies participating in the industry.

In spite of the rise in labor, transportation and other production costs, retail prices of Christmas trees did not advance materially. Prices of trees in the metropolitan markets of Minnesota varied from $1.50 to $5.00 per tree, depending on the quality.

Natural or unprocessed Minnesota Christmas trees were shipped to North and South Dakota, Iowa, Illinois and eastern points. Trees processed by Minnesota companies were sold in nearly every state in the Union.

The stabilization of the industry was helped considerably by the enactment of laws in 1933. The once prevalent practice of cutting trees with little or no regard for ownership has been practically eliminated under our regulatory laws.

State sales of Christmas trees yielded $16,313.10 during the fiscal year ending June 30, 1947, and $18,006.47 in the fiscal year ending June 30, 1948. Thus a total income of $34,319.57 accrued to the state trust fund from the sale of Christmas tree stumpage. The sale of confiscated trees in 1946 yielded $247.12, and $305.44 in 1947. In 1946 four licenses for out of state shipment yielded $800, and a like amount in 1947.

As in nearly every other sphere of public service, there has been an increase in the cost of the administration and policing of the Christmas tree industry to the point where the income derived from the sale of licenses and tags no longer is sufficient to carry the costs of the administration of this activity. It was suggested to the legislature of 1947 that the price of tags be raised. It is again recommended to the legislature of 1949 that the Christmas tree law be amended so as to permit an increase in the price of tags at least to the extent that the revenue yielded to the state will be ample to defray the costs of supervising the industry.

TABLE 17

Statement of Receipts from Christmas Tree Activities Under the Evergreen Tree Tag Law for the Biennium Ending June 30, 1948

	1946		1947	
Area	No. of 2c Tags Sold	Amount	No. of 2c Tags Sold	Amount
St. Paul	212,154	$ 4,243.08	183,264	$ 3,665.28
Cambridge	140	2.80	3,235	64.70
Moose Lake	145,389	2,907.78	134,731	2,694.62
Cloquet	94,854	1,897.08	75,264	1,505.28
Brainerd	22,212	444.24	16,721	334.42
Hibbing	22,027	440.54	10,166	203.32
Hill City	112,013	2,240.26	103,753	2,075.06
Bemidji	25,033	500.66	18,148	362.96
Park Rapids	17,745	354.90	14,985	299.70
Arago	2,679	53.58	3,957	79.14
Warroad	22,235	444.70	32,521	650.42
Baudette	1,999	39.98	906	18.12
Blackduck	12,302	246.04	12,369	247.38
Littlefork	3,357	67.14	7,851	157.02
Orr	12,019	240.38	18,761	375.22
Duluth	47,140	942.80	39,102	782.04
Hovland	1,084	21.68	20	.40
Total	754,382	$15,087.64	675,754	$13,515.08

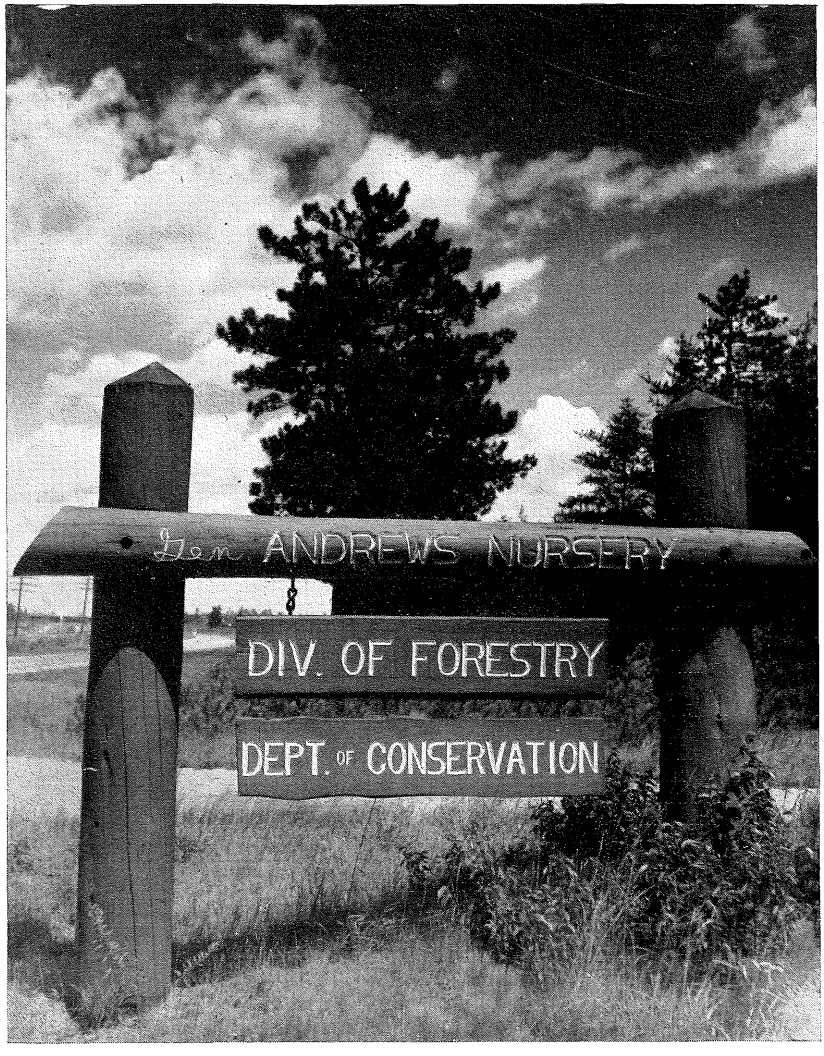
TABLE 18

Revenue Yielded the State from Operations Under the Evergreen Tree Tag Law for the Period 1936 to 1947 Inclusive

Year	Amount
1936	$10,582.31
1937	13,169.03
1938	13,653.65
1939	13,822.41

TABLE 18—Continued

Year	Amount
1940	13,132.39
1941	14,124.83
1942	10,113.09
1943	19,457.73
1944	10,519.25
1945	13,986.79
1946	16,134.76
1947	14,620.52



Sign at the entrance to the General C. C. Andrews Nursery.

FOREST TREE NURSERIES

RAYMOND CLEMENT, *In Charge*

On April 10, 1903, the forestry board approved the establishment of the first forestry tree nursery near Gull Lake in Crow Wing County but made no specific appropriation for its development.

The legislature of 1931 made the first direct appropriation to the division of forestry for the operation of a state tree nursery at Badoura. This law was restrictive, limiting production to native coniferous trees, and provided that trees grown in the nursery could only be planted on publicly owned lands. While the appropriations made by the legislature authorized the raising of trees in the nursery, prior to 1947 no appropriations were made for the planting of trees raised in the nursery on the lands where they were to grow.

Nothwithstanding these handicaps, considerable progress was made in tree planting. Between the years 1932 and 1946 more than 41½ million trees were planted on publicly owned lands. This volume of planting was aided greatly by relief labor during the distressed 30's, particularly by CCC and WPA camps. Whatever may be said of the economic worth and permanency of some of the work performed by these organizations, the trees they planted on denuded state owned and other publicly owned land will stand as a lasting tribute to their accomplishments. Thirty thousand acres of forests were thus planted.

During these same years many other organizations became interested in tree planting. Organizations like the boy scouts, future farmers of America, veterans' organizations, civic groups and chambers of commerce became active in promoting the program. Municipal forests were established over the length and breadth of the state.

In 1939 a second modern nursery was started two miles north of Willow River, on state highway No. 61. It was named the General C. C. Andrews memorial nursery in honor of Minnesota's first chief forest fire warden. This nursery was developed largely by WPA and is capable of producing at full capacity up to ten million trees annually. However, relief labor camps were suspended before this nursery was fully developed, making necessary some additional work before peak production can be attained. There is a lack of permanent housing facilities for employees and soon there will be need for an extension to the overhead sprinkling system.

Adjacent to this nursery and surrounding it is a 4,000-acre research and experimental forest where diverse experiments in broadcast seeding, planting, natural regeneration and other types of forest research are being carried on.

The General C. C. Andrews nursery, together with the Badoura nursery have a combined potential annual production capacity of 20 million trees.

As long as the relief camps were available, labor to run both nurseries was furnished by these organizations. It was not unusual to see from 75

A portion of the General Andrews nursery, showing transplant beds.

to 250 men working at one time within the nurseries. On the suspension of relief work and following, all of the work that has been accomplished has been measured by the appropriations made by the legislature. Limited funds coupled with the difficulty of finding man-power under conditions which have prevailed during and following the war, is forcing the division to turn to the mechanization, so far as possible, of the nursery and tree planting operations. Machinery of the type adapted for these purposes is not readily obtainable but frequently has to be built on the job. Operations range through the sowing of the seed, weeding of the beds, digging and packing for transportation of the seedlings and planting of them in their permanent locations, each one of which is an operation requiring a special machine. To develop and build this equipment takes times and money, and must have the needed financial support if a program of adequate nursery production and planting is to go forward.

Another important limiting factor in the prosecution of a successful tree planting program needs emphasis. The raising of the seedling to planting size, important as it is, is not the biggest job in this program. There are only a few weeks in the spring and in the fall of each year when seedlings from the nurseries may be successfully transplanted to their permanent location. The success of any year's program depends therefore on the funds and resources available during these brief periods in which to dig, pack, transport and plant the nursery stock. This period is short but unless the

division has funds and resources to build up an organization adequate to process the nursery stock in time for planting, each year's program will be retarded and those who look for trees to plant will become justly critical of the division's efforts.

Nursery transplanting machine developed by the division of forestry.

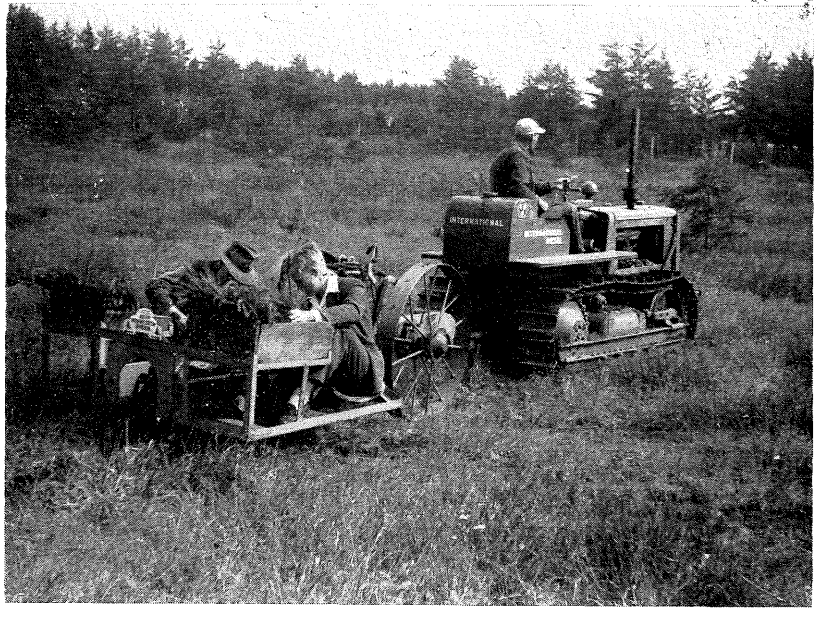
A nursery program for Minnesota adequate for current needs will first require modernization and completion of the division's two nurseries. For this sufficient funds must be made available to provide housing facilities, additional improvements to the watering system, complete mechanization of the producing and planting operations and adequate labor to carry out the nursery and planting programs.

Laws passed by the legislature of 1947 expanded the field within which state nursery stock may be supplied for planting by providing that the division of forestry may now furnish trees for conservation planting upon privately as well as publicly owned lands. This legislation was a sequel to many years of effort by leaders in forest restoration to promote a wide program of tree planting by providing planting stock at actual cost and should prove an inducement and challenge to all agencies, private and public, to plant trees in a state-wide reforestation program.

As soon as this legislation had been enacted the division immediately started the planting of tree seed to step up production in both nurseries. Scarcity of seed frequently limits the volume of planting but a sufficient

supply was available to make it possible to put considerable seed in the ground in the fall of 1947. More than eight million seed were thus planted from which seedlings ready for planting will be available in an average of from three to three and one-half years hence.

The division contemplates planting seed in the fall of 1948 in an amount estimated to produce planting stock of more than 10 million trees. At current prices of tree seed, seed will cost from $4.50 per pound to over $30.00 per pound. Based on applications received for trees in the spring of 1948, the production of ten million trees for planting planned for 1951 will not begin to approach the annual needs for trees to support the tree planting program after it has been fully developed and organized. It is believed that annual requests for trees may well reach or even exceed 50 million. Thus far planting and operations of the nurseries have been carried on without additional appropriations. It will be necessary, however, for the legislature to appropriate additional funds for further operations if the anticipated demand for trees is to be met.



Field planting with machine developed by the division of forestry.

STATE TREE PLANTING

RAYMOND CLEMENT, *In Charge*

The legislature of 1945 (Chap. 535) appropriated $3,000 as a state tree planting revolving fund and in the same act provided $4,460 for each of the fiscal years 1946 and 1947 for general expenses of administration of the state tree planting act.

Under authority of this act a contract was awarded a commercial nursery for the production and delivery of 550,000 deciduous trees. These trees were subsequently sold at prices that would liquidate costs. All expenses incurred in the administration of the tree planting program, plus the money paid the commercial nurseries under the contract were paid from the balance remaining in the revolving fund above referred to. The fund was subsequently reimbursed by the proceeds from the sale of trees, with the provision that the unused balances of each year's appropriation shall be reappropriated and transferred to the revolving fund. Table 19 is an accounting of appropriations, receipts and expenditures under the tree planting program for the fiscal years 1947 and 1948.

TABLE 19

State Tree Planting Revolving Fund

	Fiscal Year 1947		Fiscal Year 1948	
Appropriations 7/1/46	$3,000.00			
Balance 7/1/45 in State Tree Planting Fund (Administrative) reappropriated	2,108.51			
Total available funds		$5,108.51		
Balance in fund 7/1/46			$5,108.51	
Balance 7/1/46 in State Tree Planting Fund reappropriated			3,279.66	
Receipt from sale of trees			6,403.34	
Total available funds				$14,791.51
Less payments to nurseries for trees delivered				5,937.53
Balance 7/1/48 reappropriated				$ 8,853.98

Sales of trees, by counties, are shown in Table 20.

TABLE 20

SUMMARY OF TREE SALES BY COUNTIES

County	No. of Conifers Sold	Conifer Applications	No. of Deciduous Trees Sold	Deciduous Applications
Aitkin	2,700	3	1,000	2
Anoka	11,000	10	8,500	7
Becker	.....	....	500	1
Beltrami	3,000	2	200	1
Benton	11,355	13	6,335	13
Big Stone	13,500	6	11,000	12
Blue Earth	7,800	3	.....	....
Brown	400	2	3,800	7

TABLE 20—Continued

County	No. of Conifers Sold	Conifer Applications	No. of Deciduous Trees Sold	Deciduous Applications
Carlton	27,000	5	10,500	2
Carver	3,000	3	3,830	5
Cass	54,000	4	1,000	1
Chippewa	.....	....	2,000	2
Chisago	8,600	7	3,800	4
Clay	2,500	2	89,400	89
Clearwater	1,050	2	3,950	5
Cook	1,000	1	.....	....
Cottonwood	.....	....	9,393	13
Crow Wing	36,060	5	2,900	4
Dakota	10,025	10	9,645	14
Dodge	500	1	500	1
Douglas	4,750	7	7,330	12
Faribault	.....	....	1,500	1
Fillmore	1,500	2	3,000	3
Freeborn	200	1	800	2
Goodhue	60,500	27	4,000	5
Grant	.....	....	6,150	8
Hennepin	36,000	11	1,795	3
Houston	2,400	3	1,300	3
Hubbard	125,800	3	200	1
Isanti	9,700	9	3,000	7
Itasca	349,700	4	.....	....
Jackson	.....	....	17,100	24
Kanabec	500	1	385	2
Kandiyohi	1,800	3	3,275	6
Kittson	200	1	8,500	11
Koochiching	173,200	2	10,405	3
Lac qui Parle	938	1	2,000	2
Lake of the Woods	.....	....	15,200	16
Lincoln	.....	....	7,650	7
Marshall	.....	....	37,750	36
McLeod	.....	....	1,500	2
Meeker	2,150	4	1,070	3
Mille Lacs	3,275	5	4,100	6
Mower	8,500	3	2,000	3
Murray	2,000	2	2,200	3
Nicollet	975	1	1,100	3
Nobles	500	1	1,500	3
Norman	1,500	1	5,700	7
Olmsted	4,600	4	1,565	4
Ottertail	1,600	4	17,727	24
Pennington	.....	....	7,200	9
Pine	6,600	5	55,482	4
Pipestone	1,000	1	1,000	2
Polk	1,100	2	10,400	12
Pope	500	1	4,000	4
Ramsey	12,100	8	2,500	3
Red Lake	1,000	1	17,800	19
Renville	.....	....	2,500	4
Rice	.....	....	3,000	3
Roseau	3,550	2	28,800	31
St. Louis	9,500	9	1,625	4
Scott	11,000	3	1,000	1
Sherburne	29,440	45	15,060	19
Sibley	.....	....	5,000	8
Stearns	5,800	8	12,580	13

TABLE 20—Continued

County	No. of Conifers Sold	Conifer Applications	No. of Deciduous Trees Sold	Deciduous Applications
Steel	.....	....	700	2
Stevens	875	2	10,228	13
Swift	.....	....	2,000	3
Todd	9,000	6	9,725	13
Traverse	.....	....	2,050	2
Wabasha	.....	....	1,000	2
Wadena	200	2	950	3
Waseca	110	1	100	1
Washington	9,400	10	1,645	3
Watonwan	.....	....	3,000	4
Winona	8,650	4	2,300	5
Wright	500	1	8,500	8
Yellow Medicine	200	1	1,800	3
TOTALS	1,096,303	291	550,000	591

TABLE 21

Number of Trees Planted on Public Lands and Locations of Plantings Fiscal Years 1947 and 1948

STATE FOREST AND ADMINISTRATIVE SITES

	1947	1948
Administration Site	700	.....
Beltrami Island State Forest	10,000	.....
Borden Lake Site	1,400	.....
Cloquet Valley State Forest	.....	500
Coleraine Tower Site	150	.....
Crow Wing State Forest	1,000	.....
Cuyuna Tower Site	300	.....
D.A.R. Forest	5,100	.....
Demonstration Plot	13,400	.....
Emily Tower Site	1,700	.....
Fond du Lac State Forest	5,600	.....
Foothills State Forest	7,000	.....
Gen. C. C. Andrews State Forest	31,800	8,700
George Washington State Forest	8,000	10,750
Grand Rapids Station	200	.....
Grand Portage State Forest	5,000	.....
Koochiching State Forest	6,000	.....
Martin Lake Project	2,500	7,000
Mississippi Headwaters State Forest	4,000	.....
Onamia Ranger Station	100	.....
Pillsbury Forest	.....	7,950
Quadna Tower Site	500	.....
Ray Ranger Station	600	.....
Sand Dunes State Forest	304,820	419,675
Sandy Lake Ranger Station	150	.....
Smoky Hills State Forest	1,042	.....
Warroad Ranger Station	170	6,200
Washington Lake Site	300	.....
	411,532	460,775

STATE PARKS		
Itasca State Park	13,500	.....
Lake Carlos State Park	.....	500
Mound Springs State Park	.....	1,000
St. Croix State Park	3,000	42,500
	16,500	44,000
GAME AND FISH PLANTING PROJECTS		
Crooked Creek and Sucker River Project	36,100	.....
East Beaver Creek Project	.....	3,500
Gilmore Creek Project	.....	4,500
French River Fish Hatchery	.....	20,000
Norris Camp	800	.....
Other Planting	.....	84,925
	36,900	112,925
HIGHWAY RIGHTS OF WAY		
Benton County Highway	.....	400
Indus State Highway	850	.....
Littlefork State Highway	2,300	.....
New Ulm State Highway	.....	16,000
Northfield Highway 65	.....	450
Sherburne Co. Roadside Plantation	1,600	.....
St. Paul, Minnesota—Highway 61	5,000	.....
Trunk Highways Nos. 7, 21, 52, 55	2,500	.....
Trunk Highways Nos. 92, 51, 17, 23, 39	76,100	.....
Trunk Highway No. 23	.....	2,100
Trunk Highway No. 92	.....	24,850
Trunk Highway No. 218	.....	3,000
Trunk Highway No. 36	.....	5,500
	88,350	52,300
OTHER STATE-OWNED LANDS		
Anoka State Hospital	3,400	5,600
Cambridge Colony for Epileptics	.....	1,050
Faribault School for Deaf	500	2,640
Hastings State Hospital	.....	2,500
Moose Lake State Prison	600	.....
Red Wing Training School for Boys	1,000	1,500
Rochester State Hospital	.....	12,000
St. Cloud Reformatory for Men	1,700	2,000
Sauk Centre Home School for Girls	.....	350
Stillwater State Prison	.....	1,500
Willmar State Hospital	.....	4,400
Bemidji State Teachers College	.....	8,500
St. Cloud State Teachers College	2,490	1,300
Cloquet Experiment Station	600	.....
Grand Rapids Future Farmers of America	2,600	.....
Isanti County Game Refuge	.....	9,000
Lac qui Parle Project	350	300
National Guard Camp Ripley	20,000	11,300
University Farm Experiment Station		
Rosemount Research Center	.....	58,000
Alexandria, Minnesota	.....	600

Sec. 16-146-35 Beltrami Co.	.....	2,000
Sec. 19-147-34 Beltrami Co.	.....	2,000
Sec. 19-149-37 Clearwater Co.	.....	2,500
Sec. 20-55-21 St. Louis Co.	.....	4,500
Sec. 29-144-33 Hubbard Co.	.....	2,000
	33,240	135,540

COUNTY FORESTS

Anoka	10,000	40,000
Crow Wing	.....	2,000
Hennepin	.....	17,000
Itasca	.....	51,000
Mahnomen Memorial Forest	.....	10,000
St. Louis	3,000	1,000
	13,000	121,000

MUNICIPAL FORESTS

Anoka	1,500	.....
Backus	.....	10,000
Balaton	.....	225
Brookpark	.....	2,100
Crystal Village	80	.....
Duluth	20,000	7,650
Elk River	725	.....
Fergus Falls	5,000	.....
Freeport	.....	150
Glenwood	.....	18,000
Isanti	3,400	.....
Island Lake	3,000	.....
Keewatin	65	100
Moose Lake	825	.....
Nevis	.....	500
Ortonville	8,000	.....
Princeton	1,300	.....
Rochester	1,000	1,000
St. Paul	.....	10,500
Sauk Rapids	.....	1,500
Two Harbors	.....	2,000
Tyler	830	.....
	45,725	53,725

TOWN OR TOWNSHIP FORESTS

Chisholm	.....	250
Gary	2,050	.....
Orrock	251	.....
Wanamingo	2,000	.....
	4,301	250

SCHOOL FORESTS

Anoka	4,000	.....
Backus	200	.....
Bagley	500	.....
Barnum	30	.....
Baudette	10,500	.....
Becker	349	.....
Bemidji	1,000	.....

Benton County	.....	1,625
Big Falls	6,000	.....
Brainerd	.....	750
Cambridge	1,500	.....
Clear Lake	1,600	.....
Cotton	.....	1,500
Duluth	3,500	.....
Duquette	800	.....
Elk River	6,536	.....
Elmer	.....	250
Floodwood	27,300	9,000
Foley	700	.....
Greenbush	.....	800
Hamel	9	.....
Herman Twp	350	750
Hibbing	3,000	.....
Hinckley	5,200	.....
Hoffman	.....	500
Isanti County	.....	1,600
Island Lake	3,000	.....
Indus	1,050	.....
Littlefork	2,500	.....
Milaca	40,000	.....
85 Minneapolis Schools	1,240	850
Montevideo	.....	100
Nevis	2,000	2,250
Nickerson	500	.....
Northfield	125	.....
Ortonville	800	.....
Osseo	200	.....
Pine Island	300	.....
Pine River	200	.....
Rockford	200	.....
Rogers	50	.....
Sauk Rapids	200	.....
St. Bonifacius	50	.....
St. Paul	1,000	.....
Wayzata	600	.....
	127,089	19,975

RECAPITULATION

Trees Distributed for Fiscal Years 1947 and 1948

Plantings on Public Lands

	1947		1948	
State Forests and Administrative Sites	411,532		460,775	
State Parks	16,500		44,000	
Game and Fish Planting Projects	36,900		112,925	
Highway Rights of Way	88,350		52,300	
Other State Owned Lands	33,240		135,540	
Total Trees Planted on State Owned Lands		586,522		805,540
County, Municipal, Township and School Forests		190,115		194,950
Total Trees Distributed for Planting on Public Lands		776,637		1,000,490

Plantings on Private Lands

Trees Sold for Planting on Private Lands	.....	1,646,303
Total Plantings	776,637	2,646,793

LAND EXCHANGE

E. L. LAWSON, *In Charge*

An amendment to the state constitution adopted in 1938 and the enactment by the legislature of 1941 of the Minnesota land exchange act, authorize exchanges of lands owned by the state for lands owned by the federal government and lands owned by private owners. Authority to administer the act is vested in the Minnesota land exchange commission, consisting of the governor, the state auditor and the attorney general.

Prior to 1947 investigations and appraisal of lands in exchange programs were delegated by the land exchange commission to the division of lands and minerals. In April of that year this function was transferred to the division of forestry by the commission.

The main objective of the land exchange act is to effect a consolidation of state and federal lands scattered throughout the state and national forests and other areas dedicated to public use, for improved administration and management. As an illustration, state owned lands scattered throughout a national forest under federal control and management, and federal and private lands scattered throughout a state forest under state control, are alike out of place and in neither case can they be managed to the best interests of their owners. The act also provides for the exchange of lands between private owners and the state and between private owners and the counties, subject to the approval of the land exchange commission. It is to be seen how under this act carefully planned programs of land exchanges can be made mutually beneficial to both parties involved in each transaction. Lands subject to exchange are classified under the act into Class A and Class B lands. Class A includes all lands owned by the state under the control and jurisdiction of the commissioner of conservation. Class B lands are lands acquired by the state through tax forfeitures and held in trust in favor of the taxing units and which are under the control and jurisdiction of county authorities for classification, appraisal and sale.

In proceedings that affect Class A lands, the commissioner of conservation, with the approval of the land exchange commission, formulates the exchange programs. This includes an examination and appraisal of the value, not only of the land offered the state but also of the land to be given by the state in exchange and a finding that the proposal will serve the best interests of the state.

Three Class A exchange proposals were consummated during the biennium. One of these, the Nerstrand Woods, involved an exchange between the federal government and the state under conditions where the federal

government purchased some tracts of rare hardwood timber within an area in Rice County near Nerstrand which the state wished to preserve from destruction, to be given the state in exchange for state owned trust lands of equal value located within the Superior national forest. The other two Class A exchanges involved minor acreages of privately owned lands which were exchanged for state lands.

Another major exchange program pending before the commission under Class A lands proposes an exchange of lands acquired by the federal government under the so-called Beltrami and Pine Island land utilization projects located in Beltrami and Koochiching counties, nearly all of it within the Red Lake Game Preserve, for state owned lands located within the Chippewa and Superior national forests. On July 1, 1948, state land appraisers had completed appraisals on 21,132 acres of federal lands valued at $103,208 and 11,468 acres of state land with a value of $66,774 on this project. Appraisals of state owned lands within the national forests will continue until lands aggregating in value that of the federal lands to be acquired have been examined and appraised.

In addition to this major project, 30 Class A proposals for the exchange of state and privately owned lands are pending before the commission in which private lands offered the state aggregate 14,865 acres. Investigations and appraisals will be undertaken as soon as they can be reached, but with only two appraisers available in the division to assign to land exchange work, progress is slow.

Twenty Class A exchange proposals were rejected during the biennium after investigation and submission to each of the divisions of the department for consideration as being of the kind not contemplated or authorized by the land exchange act, did not properly recognize and protect the state interests, or for other reasons proved inadvisable. The various conditions under which private lands are offered to the state in exchange for state lands are such that each exchange proposal has to be carefully scrutinized. Some lands are offered the state which have no market value for any purpose. In other instances, tax-forfeited lands which have been purchased from the counties and from which all timber has subsequently been removed are offered in exchange for state owned lands more favorably located or are valuable for agriculture. Still other proposals come from absentee owners who have paid taxes for 20 years or longer on lands they have never seen, seeking some basis for exchanging them for state owned lands. These types of proposals and the motives inspiring them make it necessary that each proposal, no matter how small, be investigated as to its merits.

At the present time one Class B exchange proposal is pending before the commission in which 687.82 acres of privately owned lands are offered in exchange for 590.92 acres of tax-forfeited lands, the processing of which is nearing completion.

Recommendations for Amendments to the Land Exchange Act

Experiences thus far had with proposals for the exchange of state owned lands for federally owned lands have indicated that the procedure, especially when low cost lands are involved is unduly cumbersome and costly. The thorough examination required by the present act of such lands, both those to be offered by the state as well as those to be accepted from the government, is disproportionate to the needs and consumes more time and labor than are justified by the results and the purposes of the law. The examination and appraisal, for instance, of low value, non-productive bog and cut-over brush lands, under the present law, requires the services of two state appraisers and must extend to every tract of land, state and federal, to be affected by the exchange, with the same degree of thoroughness as is required in the appraisal of state land to be offered for sale at public sales. Under these rigid examination and appraisal requirements there are instances when the cost of these preliminary steps might well exceed the value of the lands. In order to reduce costs, save time and otherwise simplify procedures, it is suggested that the act be amended to give the land exchange commission sufficient latitude in its functioning to permit it to deal with exchanges of state owned and federally owned low value lands on a broader and more comprehensive basis. There appears to be no valid reason, for instance, why examination of lands in the lowest value bracket could not be made simultaneously by one state and one federal appraiser working together. Furthermore, large areas of low value bog, rock outcrop and other lands on which there is no merchantable timber and which are not potential sources of future timber, much time and effort could be saved if authority were granted the commission to deal with these lands in larger blocks than 40-acre tracts or government lots as at present prescribed by the act.

Aerial photographs, for instance, are now being used extensively in the general determination of extent and types of forest cover in connection with forest management. Such photographs supplemented by checking on the ground could be made sufficiently accurate in the appraisal of low value bog and rock outcrop lands to serve the purposes of the exchange and save much time and expense. Furthermore some lands affected by exchanges have already been appraised by other qualified and bonded state timber and land appraisers whose reports are available to the commission. An amendment to the land exchange act which will give the commission authority, in proposals for land exchanges between the state and the federal government, to direct the type of examinations and appraisals which conditions warrant, would definitely reduce costs, simplify procedures and expedite progress. Other states have adopted this type of appraisal in land exchanges with the federal government, and from all reports they are proving successful.

MAPS AND AERIAL SURVEYS

ROGER WILLIAMS, *Cartographer*

The need for accurate, up to date base maps, always keenly felt by the division of forestry, has increased as other phases of the fire protection system have been developed and refined. Practically all present available maps of northern Minnesota are based on data shown on the original township plats of of the U. S. Land Office. These maps lack control points whose locations have been accurately fixed by geodetic methods resulting in distortions which often make points located on available maps by line projections from lookout towers actually fall outside of the description indicated by such intersections.

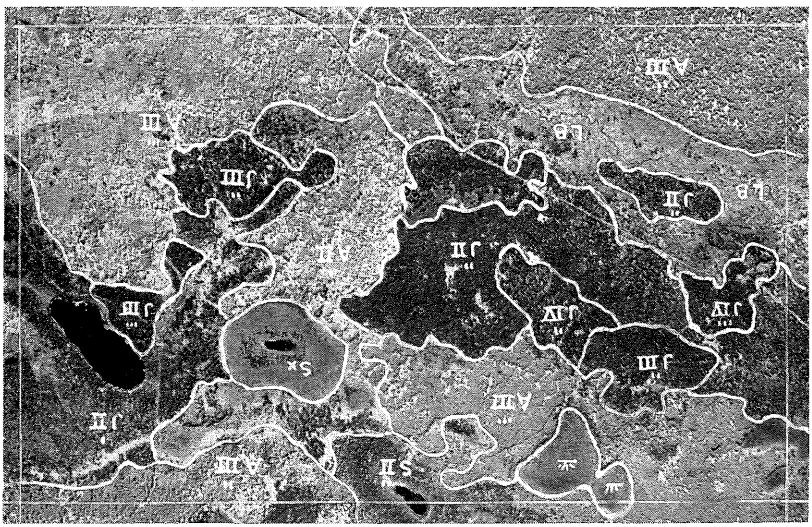
Forest fires are located from lookout towers by intersecting on a map of the area lines projected from two or more towers to the point of the fire. It is to be understood, therefore, how distortions in the maps used by observers may result in serious errors in locating and directing fire fighting crews to the fires, with consequent loss of time, increased areas burned over and greater damages and over-all costs. Such errors could be eliminated or kept to a satisfactory minimum if a sufficient number of control points, whose exact positions with reference to each other, are known. A considerable number of such points is provided by the triangulation nets established by the U. S. Coast and Geodetic Survey augmented and expanded by the U. S. Mississippi River Commission, U. S. Corps of Engineers, U. S. Geological Survey, the International Boundary Commission, and other agencies. However, the points established by triangulation nets are separated by from 30 to 50 miles between which there is no control whatsoever. Where these conditions prevail in the heavily timbered areas of the north, the need for locating accurately and tying together lookout towers and lookout towers to other accurately located points is becoming more and more keenly felt in fire detection and suppression work.

In order to correct this condition the division of forestry has begun, during the biennium, extensive surveys designed to establish a series of permanent control points distributed over the entire protection area. Using existing state and federal lookout towers and geodetic triangulation stations whose positions have been previously determined by reference to precise geodetically established points, the entire system of lookout towers is being covered by triangulation. The immediate result is to obtain the true position, by latitude and longitude, of each lookout tower and of many other points, the true azimuth or direction of the lines connecting towers and the exact distances between them. At the same time, information is obtained which may lead to the improvement of the detection system by better placement of lookout towers.

As each section of the survey is completed, the rangers are furnished with the true azimuths or directions from each tower to other towers and other points which are visible to the towerman. By means of this information it will be possible to check the orientation of the sighting device used

by the towerman, and to detect and correct errors in the district maps now in use.

In a survey covering such a large area, in order for the results to be of practical value, a fairly high degree of precision must be maintained. The standards of accuracy and methods of observing and computing specified by federal mapping organizations for third-order triangulation have therefore been adopted. Permanent points established by this means will be equally valuable to engineers and others making extensive surveys and maps, and the results will be made available to anyone on request.



Aerial photograph with type lines and symbols indicating species, size class and density of timber.

The full benefit of such surveys will not be realized until new maps are made. The division of forestry has already made limited use of the most modern and useful tool of the mapper, the aerial photograph. Aerial photographs purchased for forest management purposes are being used as an aid in compiling new township base maps. Such mapping is limited to those few areas where both photographs and adequate control points are available. When these control surveys are completed, and additional mapping equipment and up to date aerial photographs are acquired, it will be possible to produce accurate maps of any part of the protection area. By coordinating the mapping work of the division with that of other agencies in need of similar information, it should be possible to satisfy the chief mapping needs of the division within a few years.

Aerial Photographs

In order to make the fullest possible use of aerial photographs there is required:

1. Specialized equipment for photo interpretation, for making the measurements necessary on photographs, and for mapping.

2. Employees experienced in photo interpretation and trained in the use of such specialized equipment.

3. Ground control for accurate mapping.

4. Up to date aerial photographs incorporating techniques and possessing other qualities particularly essential for forestry management purposes.

Satisfactory progress has been made in meeting requirements 1, 2 and 3. During the biennium the division purchased aerial photographs of the units for which management plans are being developed. Forest type maps have been prepared, showing timber type lines, with species, size class, and density of timber. For this purpose, simple inexpensive equipment has been acquired for interpretation and for transferring information from photographs to maps. Selected employees of the division have received training and have acquired experience in aerial photograph interpretation and in the techniques of making maps and quantitative estimates of timber resources by this method.

With reference to requirement 4, practically all the photographs now being used by the division of forestry were taken in 1939 and 1940 by the Agricultural Adjustment Administration, and were not taken on the type of film nor on a scale designed to produce maps most desirable for forestry management purposes. Furthermore, in the eight or nine intervening years, timber conditions have been altered by growth, fire, disease and cutting. New roads have been built and others have fallen into disuse during this period. The amount of usable information available from these pictures is therefore limited and must be supplemented by expensive field work, checking of timber conditions on the ground, examination of cutting records, etc. With new photographs, taken on infra-red film and on the proper scale, it is possible by recently developed instruments and techniques to determine not only species of timber but also tree heights, stand density, and other factors from which a satisfactory estimate of timber volume may be made. This can be done almost entirely from the photographs, with a minimum of ground checking and at greatly reduced cost.

In 1947 and 1948 contracts were let for new aerial photographs of both the Superior and Chippewa National Forests and for the portions of Lake, Cook, St. Louis, Itasca and Carlton counties located outside of the boundaries of these forests. This work has been made possible through the active cooperation of federal, state and county authorities and private individuals. It is the plan to complete aerial photographing of all or part of nine other counties, all of which have large quantities of timber on state or tax-forfeited lands, within the next two years if the cooperating agencies will be supplied with the necessary funds. Probably the greatest potential beneficiary from this photography is the State of Minnesota because of its value to the department of conservation in the administration of the state's forest resources. Adequate funds should be provided for the purchase of photo-

graphs of selected areas and to permit the department to contribute its share towards the cost of new photography.

While the most pressing and immediate need for new photographs is for timber inventory and mapping purposes, their usefulness in other ways has already been proven. They have been found to be indispensable in planning fire control operations, studying fire hazard and topography, and locating trails and sources of water, especially in inaccessible areas. They are helpful in planning improvements, such as roads, trails and telephone lines, finding property lines, and locating desirable areas for planting. Through continued daily use by rangers, supervisors and administrative personnel, aerial photographs have a value far exceeding their cost.

RECREATIONAL AND HOMESITE DEVELOPMENTS IN STATE FORESTS

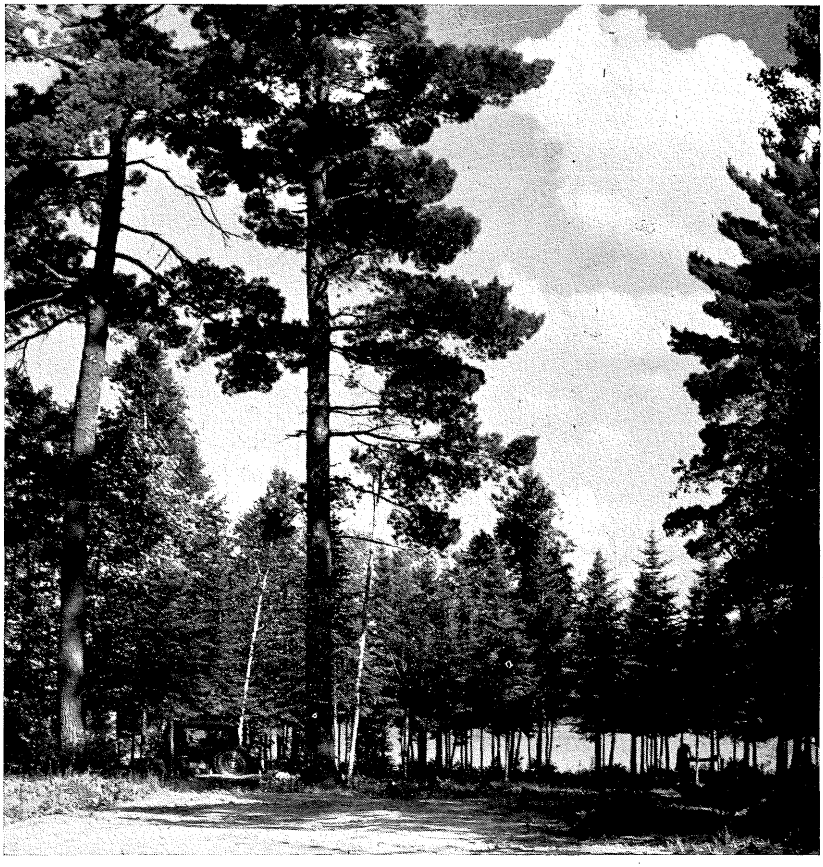
HAROLD OSTERGAARD, *In Charge*

Valuable as are our forests as a source of timber supplies, they are probably even more widely appreciated by the general public as furnishing an incomparable setting for hunting, camping, resort development, homesites, and as frames to thousands of our lakes, add much to the enjoyment of fishing, canoeing, swimming and other aquatic recreational pastimes.

Special Use Permits and Leases

The development and leasing of lakeshore summer homesites and sites for hunting cabins within state forests is expanding because of continually increasing demands for opportunities to live in and enjoy the exceptional surroundings created by forests. Naturally, people seek homesites on lakes with which they are most familiar or where reports indicate that fishing is good. There are still many attractive state owned tracts of lakeshore lands on which homesites would be eagerly sought if they were made accessible by roads for automobiles. The added revenue that the leasing of homesites on many of these tracts would yield to the state's trust funds would justify the state appropriating funds from which to construct access roads from nearest public highways.

In addition to the platting, leasing and management of lakeshore homesites, lands within state forests are in demand for haying and farming, location of commercial enterprises, rights-of-way for railroads, highways, telephone and telegraph lines, gravel pits and other uses. These demands have shown a slow but steady increase. Table 22 shows use permits in force for the years 1945-1948, inclusive, and revenues yielded by each class.



Public campground in the Kabetogama state forest.

TABLE 22

Permits in Force and Revenue Collected

	1945		1946		1947		1948	
Homesites	289	$3,050.00	324	$3,470.00	409	$4,240.00	426	$4,370.00
Hay and Farm	190	1,491.51	157	1,220.46	179	1,473.14	220	1,767.64
Commercial	54	2,047.43	60	1,471.28	57	1,543.00	53	1,220.00
Rights-of-way	31	204.42	23	163.92	31	159.80	36	370.80
Gravel	.....	.....	.....	.....	6	354.18	9	3,459.64
Total	564	$6,793.36	564	$6,325.66	682	$7,770.12	744	$11,188.08

Campgrounds

Tourists and people generally love to camp and, without much thought to consequences, feel free to stop along roads and trails especially in attractive forest surroundings to build their fires and enjoy their picnic anywhere, regardless of who may own the land. It is the policy of the division of forestry to allow the widest possible latitude in the enjoyment of this use of

our forests, and, within bounds, encourages such use. It has become necessary, however, for sanitary reasons and in order to prevent the setting of disastrous fires to put into effect a measure of controlled camping and picnicking within the forests. This is being done by the selection and development of campgrounds to which camping and picnicking forest visitors are directed. Some of these grounds are equipped only with fireplaces and small areas cleared of brush, while others are more completely provided with sanitary water, tables, garbage pits, latrines and fireplaces.

All of these grounds in varying degree require maintenance and cleaning up, usually once each week. No special employees have thus far been assigned to campground supervision, the work having fallen on the regular ranger forces stationed in the areas. The added attention required in the care and orderly operation of these areas because of continually increasing demands by the public, however, is assuming proportions which make it necessary to hire special employees who can devote all their time to campground management during the summer months.

Table 23 lists present campgrounds by state forests.

TABLE 23

Forestry Campgrounds

Name	Location by State Forest
Ash River	Kabetogama
Baptism River	Finland
Bass Lake	Paul Bunyan
Bear Lake	George Washington
Bear Trap	Kabetogama
Beatrice Lake	George Washington
Bemis Hill	Beltrami Island
Berry Picker's Camp	Pine Island
Eks	Kabetogama
Faunce	Beltrami Island
Finland	Finland
Gappa's Landing	Kabetogama
Grant Lake	Mississippi Headwaters
Greer Lake	Crow Wing
Gulch Lake	Foothills
Indian Lake	Cloquet Valley
Island Lake	Cloquet Valley
King Williams	Kabetogama
Littlefork	
Lost Bay	Kabetogama
Namakan Island	Kabetogama
Norris	Beltrami Island
Owen Lake	George Washington
Pickerel Lake	George Washington
Roy Lake	White Earth
Roy Lake Beach	White Earth
Sandy Lake	Savanna
Stony Brook	George Washington
Thistledew	George Washington
Wake-Em-Up	Kabetogama
White Face	Cloquet Valley
Wood Duck Island	Kabetogama
Woodenfrog	Kabetogama

BUILDINGS AND ADMINISTRATIVE SITES

HAROLD OSTERGAARD, *In Charge*

The mechanization of fire fighting techniques has made housing for equipment an added essential item of cost of forest administration. Dozers, heavy plows, tractors, large trailers and trucks are constantly being added to the division's fire prevention and suppression plant as needs arise and funds become available, and represents a considerable investment of public funds. To preserve this equipment against rapid deterioration, a number of large warehouses have had to be constructed at strategic points throughout the forested area.

Because of the rapid increase in the costs of labor and material following the war a study was made of the relative costs at which warehouses could be built by contractors on competitive bids as against the costs of building by the division's own personnel. These studies show that under present unsettled costs and uncertainties that contractors have to reckon with in their estimates, that a saving of from eight to ten thousand dollars on the larger warehouses could be made by having the work done by a specail building crew engaged by the division. Seven major buildings were constructed during the biennium under this plan. In addition, three buildings were moved to new sites and converted to storage sheds. Table 24 lists total warehouses constructed by locations and sizes.

Hibbing area headquarters office and bunk building.

TABLE 24

Warehouses Constructed During Biennium Ending June 30, 1948

Location	Size	Description
Alborn	30′ x 64′	Combination Warehouse—Office
Backus	30′ x 64′	Combination Warehouse—Office
Cambridge	30′ x 56′	Combination Warehouse—Office
Northome	30′ x 64′	Combination Warehouse—Office
Littlefork	30′ x 66′	Combination Warehouse—Shop
Spooner	30′ x 66′	Combination Warehouse—Shop
Effie	20′ x 26′	Office

Additional buildings which are needed for storage of equipment on hand and offices are listed in Table 25.

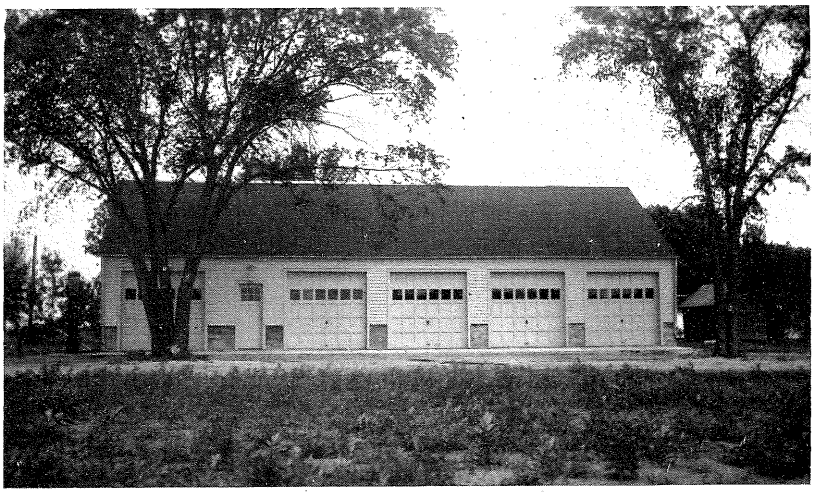
TABLE 25

Proposed Additional Buildings

Location	Size	Description
Alborn	24′ x 32′	Cabin
Birchdale	24′ x 32′	Cabin-Office Addition
Cloquet	30′ x 66′	14′ x 20′ Warehouse
Grand Rapids	60′ x 150′	Repair Shop
Loman	30′ x 54′	Warehouse
Onamia	16′ x 18′	Cabin Addition
Schoolcraft	30′ x 65′	Warehouse—Office
Spooner	26′ x 40′	Office
Warroad	26′ x 40′	Office

In the maintenance of existing buildings, exteriors of buildings are painted every five years and the interiors as needed. This mainenance work is done by a traveling paint crew augmented by ranger labor. Keeping buildings adequately painted probably represents 75 per cent of the total maintenance costs.

Table 26 lists sites acquired for administrative structures during the biennium.



Warroad area headquarters warehouse.

TABLE 26

Sites Acquired for Administrative Structures During Biennium Ending June 30, 1948

Location	Acres
Cambridge	1.0
Duxbury	2.0
Effie	2.75
Hill City	.25
Loman	3.0
McGrath	2.5
Schoolcraft	40.0

Ten additional parcels of land should be acquired for new sites in the northern part of the state for present needs. Furthermore, if intensive fire prevention and suppression services are to be extended to the southern and western counties, and with the development on a major scale of the tree planting program authorizd by the legislature of 1947, additional administrative structures to properly house planting and other equipment as well as personnel will be needed at centrally selected sites located in these sections of the state.

PRIVATE FOREST MANAGEMENT SERVICE

M. J. LATIMER, *Project Forester*

"Minnesota's Forest Wealth," published by the Minnesota Forest Industries Information Committee in its 1946 report, divides forest land ownership in Minnesota into four classes, showing acreage and percentage of total in each class, as follows:

Ownership	Acreage	Per Cent of Total
State and County	7,100,000	43
Federal	2,670,000	16
Farm Woods	4,330,000	27
Other Private Ownership	2,600,000	14
Total	16,700,000	100

Forest lands owned by public agencies, aggregating nearly 10 million acres, are now under forest management, or will be in the near future. Commercial or industrial owners too, especially the larger ones, are recognizing that the continuation of their business for any appreciable length of time into the future will depend on analyzing and taking inventory of their present and potential future sources of material and are looking for ways and means of making their forest land holdings produce a dependable sustained yield for their support and are introducing and practicing forest management.

As against these public and industrial groups who have the organizations and means to apply recognized forest management practices are the

farmers and individual owners of small forest tracts who own in the aggregate more than one-fourth of the state forest lands. They are not organized so as to be able to manage their forest farms and woodlots cooperatively, and individually cannot afford to engage trained foresters to aid them. While the university extension service has been doing splendid work in a statewide educational campaign to promote interest among farmers and small forest farm owners in their sources of wood and lumber, the service has lacked funds with which to carry on intensive demonstrations or give aid to all of the individual farmers and others who should be contacted. Although the need of help is most acute within the forested areas, there is perhaps not a single county in the state where some form of forest farm, woodlot or shelterbelt direction is not needed and where the timber resources cannot be made to affect in some degree the economy of individual owners and communities.

The possibilities which exist of making farm forests and woodlots real sources of much of the timber products sought by forest industries has enlisted their interest in having forestry practices introduced to this class of owners of small individual tracts of timber.

Organization

In 1946, $8,000 was donated to the division of forestry by the Minnesota Forest Industries Information Committee from which to employ two project foresters who were to furnish private owners of small forest tracts competent forest management services in marking, measuring and marketing forest products. Their services were confined to the northeastern 14 timbered counties of Minnesota. Each forester was assigned to roughly one-half of the area. The eastern half was headquartered at Duluth and the western half at Bemidji. Work under this gift terminated June 30, 1947, and has been continued since that time as a public service by the division of forestry under authority of an act passed by the legislature of 1947 and an appropriation of $10,000 for the fiscal year 1948, and $10,000 for the fiscal year 1949. This act extends forest management services to the entire state but limits it to owners of 1,000 acres or less. The act further provides that a reasonable charge may be made by the commissioner of conservation for such services. Charges, however, are made only where owners request the actual cruising, estimating and marking of salable timber. In every instance the land owner is given a report of the results of investigations and when requested is assisted in contacting buyers for his timber products. Those interested in having their timber cruised only are referred to consulting foresters or timber cruisers.

In January, 1948, the state received assistance for the program from the U. S. Forest Service under the Norris-Doxey Act, making it possible to add another project forester and divide the state into three areas. At present Area 1 has the 26 northwestern counties with headquarters at Park Rapids. Area 2 includes the 28 northeastern and central counties with headquarters at Cambridge. Area 3 embraces the 33 southern counties and is headquartered at Faribault.

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Accomplishments

This is the first two years of operation under the private forest management service act passed by the legislature of 1947 and under the plan sponsored by private funds in effect prior thereto. It has been pioneering in a new field and the service is still far from a "going concern." Most of the time spent thus far by the foresters assigned to the work has been devoted to acquainting owners of small forest tracts of the availability of the service, its nature and purposes, and in developing a workable plan of operation. No one questions the possibility of greatly augmenting timber supplies through the orderly management of even the smaller forest lots, but there is need for considerable educational work among the owners as revealed by the experiences of the first two years. Requests for management advice are increasing but it is apparent that too few small timber and woodlot owners understand what the service means, how to avail themselves of it, and what benefits really can be gained.

Because of the work entailed on these preliminary preparations on which to organize for the future, the number of actual projects dealt with and the acres affected are not a true measure of accomplishments nor should they be accepted as an indication of the extent to which small forest tract owners will seek this service in the future, when its nature and purpose have become more widely known and demonstrated.

Requests for management service have been more numerous from small timber owners who live or own timber land in the near vicinity of the headquarters of the project foresters, this because of the greater convenience afforded nearby owners to seek and the foresters to contact and explain the service to them. Because of the large areas that have been apportioned to each of the three forsters now assignd to give this service to the entire state, it will take a long time for the results of their educational work to be reflected generally throughout their areas.

The ability of different owners to adopt the recommendations for management vary considerably. Resident owners, for instance, can do much more than non-residents to adopt improved practices because of the personal attention they can give to their problems. But residents because they are constantly on the ground and have been convinced of the value of the service, also require more attention by the project foresters. It is already apparent that as this service becomes more widely known a greater number of foresters, each assigned to a smaller area, will be needed to provide the advice to be sought.

Up to June 30, 1948, 113 requests affecting 7,931 acres in 18 counties have been acted upon, from which an estimated 1,054,000 ft. B. M. of forest products was harvested under improved cutting practices. The approximate returns to owners from stumpage totalled $10,143 from which logs, pulpwood, posts and other items yielded a gross of approximately $29,937.

Not all of the above requests netted an immediate return to the owner. Quite naturally some of the requests for advice came from owners who had

no timber yet ready for cutting. In such cases the owners were advised how best to manage their forest lands for the earliest returns. Many owners were interested in planting trees on lands not suitable for agricultural development. Other requests came from operators of small sawmills who sought advice on the marketing of their production, and from farmers who had sawed lumber, logs, posts, poles and pulpwood for sale. It can be understood, therefore, that much of the value of a service of this nature cannot be measured in immediate returns. The general satisfaction expressed by all those who have received aid is the best evidence of its value and that it is proving an effective means of stimulating a wider appreciation of the value of timber even on small tracts.

AUXILIARY FORESTS AND MEMORIAL FORESTS

ELIZABETH BACHMANN, *Secretary to the Director*

Auxiliary Forests

From the time of the passage of the so-called "auxiliary forest act" in 1927 (Chap. 247) until July 1, 1946, only 12 auxiliary forests had been established. The law was amended in 1945 and again in 1947 and as a result interest in designating lands for forestry under the law has greatly increased, with 20 additional applications having been received in the interim. Contracts for 11 of those in the latter group have been consummated and the remaining nine will be completed shortly, bringing the total number of auxiliary forests thus far established to 32. They comprise an aggregate area of 133,643 acres of privately owned lands, the owners of which have entered into contracts with the state to administer them as forest lands under a definite conservation and land use plan.

An auxiliary forest may be established on any area of land suitable for the production of timber of not less than 35 acres in area. Any area of land not less than five acres nor more than 40 acres, on which trees are growing or will be planted, and is protected from fire, insects and disease by the owner or tenant living on or near it, may become a woodlot auxiliary forest.

The act, being in effect a deferred tax law, is proving an inducement for owners of timber land, who, because of high current taxes, normally would allow their lands to forfeit, to retain title and thus is an aid in staying tax delinquency. The present ad valorem tax is removed on such land and in lieu thereof the land becomes subject to a fixed annual tax of six cents per acre during the life of the contract. Contracts may run for a period of not to exceed 50 years with the privilege of renewal, by mutual agreement between the owner and the state, for an additional period not to exceed 50 years. No tax is levied against the timber until it is harvested. The taxing provisions of the law were amended by the legislature of 1947 (Chap. 467) and now provide that the owner of an auxiliary forest shall pay a yield tax of 40 per cent on timber merchantable at the time of the signing of the contract and cut within one year, and that each year thereafter the yield tax

shall be reduced by 2 per cent, until it has reached 10 per cent, after which it shall remain constant. Timber which matures to merchantable size during the life of the contract, if and when harvested and marketed, shall be subject to the same 10 per cent yield tax.

Table 27 shows auxiliary forests by counties and acreage of each.

TABLE 27

Auxiliary Forests

County	No. of Forests	Acreage
Carlton	1	560.00
Clearwater	1	160.00
Hubbard	2	4,782.43
Itasca	7	22,771.03
Koochiching	15	65,438.84
Stearns	1	40.00
St. Louis	5	39,890.64
Total	32	133,642.94

Memorial Forests

Laws 1945, Chapter 247, authorizes the establishment by counties of memorial forests. Seventeen of such forests, embracing an aggregate area of 636,673 acres of land and dedicated to the men and women who gave their services and their lives to their country in World War II have been established to date. They are set aside from tax-forfeited lands and are to be managed on forestry principles by the county boards. Any money received as income from the land so dedicated may be expended for its development and maintenance.

Besides being living memorials and lasting expressions of gratitude to those who served, they will be a source of enjoyment for the men, women and children of today as well as the generations yet to come, and in time will add to the timber resources of the communities where they are located.

Table 28 indicates the acreages in the various counties so dedicated:

TABLE 28

Memorial Forests

County	No. of Forests	Acreage
Becker	6	44,344.01
Beltrami	2	480.00
Cass	1	63,904.46
Hubbard	1	10,825.46
Itasca	1	22,620.00
Mahnomen	1	240.00
St. Louis	6	494,259.00
Total	17	636,672.93

FOREST INSECTS AND FOREST TREE DISEASES

ARTHUR F. OPPEL, *In Charge of Special Projects*

The forest insect and forest tree disease survey being conducted by the division of entomology and economic zoology, the division of plant pathology and botany, University of Minnesota, and the state entomologist in cooperation with the division of forestry was continued through the biennium.

The report compiled by Dr. A. C. Hodson, division of entomology and economic zoology, and Dr. C. M. Christensen, division of plant pathology and botany, University of Minnesota, for 1946 and 1947, reflects the results of this cooperative project and is incorporated herewith.

Minnesota Forest Insect and Disease Survey Report for 1946 and 1947

by A. C. HODSON
Division of Entomology and Economic Zoology

and

C. M. CHRISTENSEN
Division of Plant Pathology and Botany
University of Minnesota

General Conditions in 1946

The mean temperature and rainfall were a little above normal in 1946, and spring was much earlier and somewhat drier than usual. Records of plant growth taken since 1908 at University Farm show 1946 with the earliest start of the growing season since the all time record for the year 1910. However, the unusually warm weather of March and April was followed by severe killing frosts May 11-12, with a heavy snow the night of May 12. These frosts occurred after tree growth and insect activity were well advanced in the northern two-thirds of the state, with the exception of a few localities in the northern tier of counties and along the shore of Lake Superior. A survey of minimum temperatures and frost injury was conducted because late frosts can affect insect abundance either directly, or indirectly through frost defoliation. Information was obtained through correspondence with the area supervisors of the state forest service. The results of the survey are tabulated below.

TABLE 29

FROST RECORDS, MAY 1946

Locality	Minimum Temperature May 10	May 11	May 12	Remarks
Itasca State Park..	25° F.	13° F.	12° F.	Aspen defoliated, both new and old growth of spruce and balsam fir showing severe damage.
Bemidji	26	18	18	Severe damage to aspen foliage, and to both new and old needles of spruce, balsam fir and white pine.

Hill City	30	17	29	Light frost damage to aspen; general browning of balsam fir in two townships.
Deer River	30	17	29	Considerable frost damage to aspen, spruce and balsam fir.
Pencer	27	18	25	Aspen badly injured; new growth on balsam fir and spruce killed by frost.
Littlefork	30	23	17	Aspen leaves leafing out, only tips frozen; balsam fir browned by frost.
Moose Lake	34	19	20	Severe frost injury to aspen, spruce, balsam fire, oak and ash.
Hibbing	30	19	20	Aspen buds opening, only slight frost injury; no damage to balsam fir and spruce reported.
Cloquet	33	21	21	Aspen buds only partially open, slight damage; no frost injury to balsam fir and spruce.
Duluth	29	23	24	No frost injury reported, aspen buds opening at time of frost.
Brainerd	32	25	21	Oaks defoliated by frost, no apparent damage to aspen, light injury on spruce.
Orr	32	25	25	No frost injury observed.
Grand Marais	35	29	26	No new growth had appeared at the time of the frost, no injury.

Throughout the area where heavy frost damage occurred oaks, ash, and hackberry were defoliated completely. Balsam fir and white spruce appeared red in the vicinity of Bemidji, Cass Lake and Blackduck as the result of injury to both new and old growth. However, even though the new shoots were killed a high percentage of the trees recovered from the injury. The freezing of aspen foliage may have delayed the development of another outbreak of the forest tent caterpillar because the larvae hatch and start feeding just as the buds are breaking open.

Diseases Reported in 1946

Leaf and twig blight of aspen was reported from several different areas but as usual did not appear to be causing a significant amount of damage.

Leaf rust of jack and red pine (alternate host, goldenrod) was found on trees varying in size from seedlings to those six feet high. In most cases only a small proportion of the needles were infected.

The canker rust, or sweetfern rust of jack pine, was found on as many as ten per cent of the jack pine 4 to 8 inches D.B.H. in certain stands at the Cloquet Forest Experiment Station. All of the infections were on the trunk, from 3 to 20 feet above the ground. Most of the cankers were 2-3 feet long and varied from ¼ to ½ the circumference of the trunk. This rust does not kill quickly but deforms the trunk to some extent; in some cases apparently stunts the trees, and occasionally allows decay to start. This rust can be recognized with certainty only during late May and early June when the orange colored aecia are present; even at that time a close inspection may be required to distinguish this infection from injuries caused by por-

cupines or lightning scars. Since this rust may be far more prevalent and may be causing more widespread damage than has been indicated by the survey so far, any information contributed on its occurrence would be of value.

Jack pine gall rust appears to be increasing in areas where it has been known to be present in considerable amount. It is becoming more important in several plantations near Brainerd, and should weather favorable to its spread prevail for a number of years it may become a factor of some significance where jack pine and red oak occur together. Young galls caused by this rust were found in plantations at Willow River and Cloquet.

Spruce needle rust was reported from several localities but there were no severe infections. The heaviest infection observed by the writers was seen at the Cloquet Forest Experiment Station.

Jack pine needle cast was conspicuous but caused little serious damage in plantations at the General Andrews Nursery, Brainerd, Cloquet and Brimson.

White pine blister rust was observed at various places along the north shore of Lake Superior, particularly in the vicinity of Beaver Bay.

Insects Reported in 1946

The most important records made during the 1946 season were evidence of a marked increase in abundance of the larch sawfly in several localities, reports of a further increase of defoliation of both jack and red pine by LeConte's sawfly, and the sudden development of an outbreak of the white-marked tussock moth in Minneapolis. Other notes of significance are the low population level reached by the jack pine budworm, and the further decrease in abundance of the European spruce sawfly. The presence of small numbers of nymphs of the northern walking stick in 1946 is of interest because this species, due to a two-year life cycle, has appeared in large numbers only in the odd numbered years 1941, 1943 and 1945. The presence of even small numbers of nymphs this year suggests the possibility of the development of another brood that may become important during even-numbered years.

Jack Pine

The jack pine budworm continued its decline in numbers, causing no heavy defoliation in 1946. Light infestations were reported from Cass Lake, Warroad, Brainerd and Scribner.

The jack pine sawfly was found more commonly early this season than had been observed for several years. Local, light infestations were reported from Garrison, Gull Lake, Park Rapids, Cass Lake and Itasca State Park.

The pine pitch nodule-maker was common in both natural reproduction and in plantations.

The red-headed pine sawfly caused much more complete defoliation in 1946 than ever reported before. Control measures were necessary near the

following localities: Cloquet, Hill City, Aitkin, Zimmerman, Anoka, Cambridge, General Andrews Nursery and Cotton. In previous years jack pine had been attacked almost exclusively, but in 1946 some stands of red pine were heavily infested.

Swaine's sawfly was reported this year, the first record of the occurrence of this species in Minnesota. Small numbers of nearly full-grown larvae were found on jack pine at Brimson and General Andrews Nursery about the middle of September.

The red-headed jack pine sawfly which had become very rare was found in small numbers in plantations located near Brainerd and Itasca State Park.

The introduced pine sawfly was found on jack pine in a plantation at the Carlos Avery Game Refuge.

A shoot moth which has been referred to in previous reports as either the Nantucket pine shoot moth or the Zimmerman pine moth is now considered to be neither. This species bores in the leader and laterals causing the affected shoots to break near the base. Severe damage was reported in plantations located near Cloquet, Brainerd, Itasca State Park, Willow River and Ely.

The Zimmerman pine moth damaged trees infected with pine rust gall or those with pruning wounds near Brainerd, Park Rapids and the General Andrews Nursery.

Other species of less importance in 1946 were the following: the white pine weevil, Blackduck and Cloquet; the pine webbing moth, Brainerd, Outing and General Andrews Nursery; the pine tortoise scale, Cloquet and General Andrews Nursery; and the pine spittle bug, Brainerd and Park Rapids.

White Pine

The only serious infestations in white pine was an outbreak of the introduced pine sawfly in a 25-year-old plantation at Lake Vadnais. Some trees were defoliated completely and others were badly injured. This species was reported also on white pine planted near Zimmerman and Hill City. These reports extend the known range considerably farther north.

Other species present on white pine but causing little damage were the following: pine bark aphid, Blind Lake; white pine weevil, Blind Lake, Cloquet and Itasca State Park; and white pine aphid, Brainerd.

Spruce

The spruce budworm was present in small numbers on white spruce in the following localities: Duluth, Finland, Grand Marais, Warroad and Makinen.

The yellow-headed spruce sawfly caused light damage to the new growth of spruce at Grand Marais, Bemidji, Hovland, Orr, and Gnesen. The green-

headed spruce sawfly was found in very small numbers at Pencer, and Grand Marais.

The spruce sawfly was found on black spruce in small numbers at Itasca State Park and Hovland.

The spruce gall aphid was found for the first time on an ornamental blue spruce in Duluth. Douglas fir and blue spruce were found together in the planting.

Tamarack

The larch sawfly showed a marked increase over the numbers reported in 1945. Areas of complete defoliation were found near Gatzke, Pencer and Bagley. Other infested tamarack stands were reported at Deer River, River, Itasca State Park, Finland, Pinewood and the Cloquet Valley. A survey was conducted by the rangers to determine the presence of infested stands, and to obtain a record of the acreage of tamarack which might become infested in each forest area. The results of the survey are given below.

TABLE 30

Larch Sawfly Survey

Area	Tamarack Stands	Infestations
Cloquet	Mostly small, scattered	None
Brainerd	Mostly small, scattered	None
Hibbing	Several large stands	None
Hill City	Several large stands and many small areas	None
Bemidji	No large stands	Light to heavy
Park Rapids	Small stands, scattered	None
Itasca State Park	Small stands, scattered	Light
Warroad	Several large stands and many small ones	Heavy
Baudette	Small stands, scattered	None
Blackduck	Small stands, scattered	Light to heavy
Orr	Small stands, scattered	None
Duluth	Small stands, scattered	Light to medium
Grand Marais	Small stands, scattered	None

Birch

The outbreak of the birch leaf-skeletonizer has subsided to the point where very little evidence of this species was seen in 1946.

Miscellaneous Hardwoods

The white-marked tussock moth outbreak in Minneapolis covered many city blocks and resulted in complete defoliation of elms in several areas. A survey of pupae made in October showed a high mortality as the result of parasites and disease, the latter being the most important where the heaviest concentrations of cocoons were found.

The fall and spring cankerworms continue to cause light to medium degrees of defoliation in the Twin Cities.

A very heavy infestation by the poplar leaf roller was found along the shore of Lake Superior between Hovland and the Pigeon River.

The forest tent caterpillar was reported twice, one specimen being found near Orr and one north of Hibbing.

General Conditions in 1947

The temperature and rainfall were both about average for the year, but the average temperature for October was a record-breaking high and drought and high temperatures marked the close of July and early August. Spring was much later than usual with plant growth indicators showing it to be the latest spring in 40 years. As the result some insects such as the jack pine sawfly were still active as much as three weeks later than ever observed before. The contrast between 1946 and 1947 was very striking, the former with one of the earliest springs on record and the latter the latest since records of the sort have been made.

Diseases Reported in 1947

There were some light infestations of several diseases found during the summer, but none reaching serious proportions. The pine rust galls were found commonly near Brainerd, Cass Lake and Willow River where jack pine are planted near red oak. Galls on branches are of little or no significance to the survival of these trees, and stem galls which can kill the trees occur only rarely.

A severe infection of goldenrod rust was found on red pine planting near Garrison. This disease overwinters on the leaves of goldenrod and aster and the destruction of these plants is the only control known. Damage was not too severe, causing only a slight defoliation.

Plantations in the Willow River and Cloquet areas showed some defoliation from needle cast. The infected trees were scattered throughout the plantings. There appeared to be an inherited resistance in some of the trees to these fungi, in that some of them contiguous to badly infested trees showed no signs of infection.

The black canker of aspen appears to be increasing in prevalence. It is generally distributed in the state and constitutes a menace to the aspen. The cankers formed on the trucks of aspen promote rot and make the trees more liable to wind-throw. Areas around the northeastern part of the state seem to be the most heavily infected.

Insects Reported in 1947

The most important reports from the field during 1947 were those concerning the continued increase in damage caused by the larch sawfly, the occurrence of an outbreak of the jack pine sawfly, extensive defoliation by the northern walking stick, an increase in the number of the forest tent caterpillar, defoliation by cankerworm, and extensive damage caused by an unidentified shoot moth in jack pine.

Jack Pine

The jack pine budworm caused moderate defloliation only in the Brainerd area. The population was at the lowest point recorded since the inception of the survey in 1939.

The pine shoot moth was very abundant in young jack pine over most of its range. The leaders were killed by this insect in both natural reproduction and plantations. The degree of infestation ranged from 15-70 per cent of the leaders killed. The heaviest damage was observed near Cass Lake and the Cloquet Forest Experiment Station. This is the first record of the occurrence of this species in the United States according to information obtained from the National Museum in Washington.

The pine pitch nodule-maker was very abundant in natural reproduction and plantations all over the northern half of the state.

The pine tortoise scale caused some damage to young jack pine near Brainerd, Willow River and Cloquet.

LeConte's sawfly was very abundant in plantations and roadside plantings at Cambridge, several localities in Anoka County, Willow River, Cloquet and Hill City. It was found attacking red pine near Willow River where all the jack pine in a mixed planting had been killed in 1945 and 1946.

The jack pine sawfly caused complete defoliation of the old needles of jack pine and considerable damage to red pine in the vicinity of Brainerd, Park Rapids and Badoura. An egg survey made in September, 1947, showed a heavy deposition of eggs in all the areas previously defoliated and indicated that some extension of heavily populated areas can be expected in 1948.

Other insects of lesser importance in 1947 were the pine spittle bug, the white pine weevil, the pine bark aphid and other aphids.

Red Pine

The jack pine sawfly caused some damage to red pine in mixed stands of red and jack pine near Brainerd. The old needles were seldom completely devoured as was the case for jack pine.

The pine root-collar weevil killed a few trees in a plantation near Thistledew Lake.

White Pine

The introduced pine sawfly was reported from Lake Vadnais, on nursery stock at Castle Rock and Kenyon, and on trees in a roadside planting near Zimmerman. There has been a considerable extension of the area of known distribution since the records were taken in 1946. It was necessary to spray the Lake Vadnais plantation again to prevent complete defoliation of white pine.

Spruce

No large numbers of important insects were found on spruce in 1947. In the early part of the season aphids were numerous enough to cause some

browning of terminal growth but this injury was not serious. Of the insects reported, the following are worth mentioning: the spruce webbing moth (Cambridge), the spruce bud scale (Pencer and Lake Vadnais), the yellow-headed spruce sawfly (Blackduck and Ely), the European spruce sawfly (Duluth, Makinen, Grand Marais and Hovland), the spruce budworm (Grand Marais and Hovland), and the green-headed spruce sawfly (Grand Marais and Hovland). The European spruce sawfly has extended its range along the shores of Lake Superior but has not yet developed to the point where there has been any appreciable defoliation.

Tamarack

The larch sawfly has been undergoing a general build up in the state and in 1947 was found widely distributed in areas where tamarack occurs. Reports of moderate to heavy infestation were received from Cass Lake, Park Rapids, Tower, Pinewood, Grand Marais, Hovland, Duluth, Littlefork, Bagley, Bemidji, Pencer, Baudette, Itasca Park, Orr, Blackduck and from the northeastern part of Koochiching county. The heaviest damage occurred at Bagley, Duluth, Orr, Koochiching county, Cass Lake, Pencer, Blackduck, Itasca Park and Park Rapids.

Marlatt's sawfly was reported from Makinen, Grand Marais, and Hovland.

Miscellaneous Hardwoods

The fall and spring cankerworms again caused moderate defoliation in the Twin Cities, while the fall cankerworm caused heavy defoliation at Orr and Staples.

The northern walking stick caused complete defoliation of over 1,000 acres of mixed hardwoods west of Gull Lake. Other areas in which there was serious damage were found at Pillager, southern and eastern Becker County, Sebeka and Roy Lake. A woodlot of about 200 acres of mixed basswood, maple and oak was completely defoliated east of Farmington and a similar area near Oronoco, north of Rochester, was badly infested. A new center of infestation was discovered at St. Croix State Park. Some farm crops such as corn, soy beans and garden truck were damaged my migrating walking sticks at Farmington and Pillager.

The variable oak caterpillar caused heavy defoliation of basswood and oak at Itasca State Park, Osage and Gull Lake.

Considerable numbers of forest tent caterpillars larvae were collected near Hibbing, Ely and Orr. There are definite indications that another major outbreak of this insect is on the way. Likewise more tents of the eastern tent caterpillar were seen in 1947 than had been observed since 1937 or 1938.

The fall webworm caused complete defoliation of all deciduous trees on two small islands located in the large bay near the narrows of Lake Vermillion. This infestation is of biological interest because there has been heavy defoliation by this species only under similar circumstances in this state.

A survey was made of damage caused near the base of young aspen by the poplar borer. Trees growing under various site conditions were examined, and it was found that only those growing on poor sites were heavily infested. Under poor or "off" site conditions from 70-80 per cent of the trees often were infested while less than 5 per cent showed borers when trees were grown on good sites. The degree of infestation on medium sites fell in between that of the extreme.

The oak twig girdler was unusually abundant on oaks in Hennepin, Ramsey, Anoka and Sherburne Counties. Dead flags caused by this insect were very conspicuous throughout the area.

WHITE PINE BLISTER RUST CONTROL*

L. B. RITTER, *Pathologist in Charge*

White pine blister rust control is conducted by the division of forestry in cooperation with the bureau of entomology and plant quarantine, United States department of agriculture. The responsibilities of the federal personnel assigned to the activity include the technical direction of blister rust control work on lands managed by the U. S. forest service and the U. S. Indian service. This includes the development of control procedures, the training of temporary personnel and the inspection of completed work.

White pine blister rust is a disease of European origin and affects the white pines and the various wild and cultivated currants and gooseberries. The disease does comparatively little damage to the currants and gooseberries. It kills white pine trees. Small white pine are often killed by the disease within a year or two. On the other hand, a long period of years may be required to kill older trees.

Blister rust spreads from affected white pine trees to currants and gooseberries and from currants and gooseberries to white pine trees by means of wind blown spores. It cannot spread from one white pine tree to another. Individual stands of white pine can be protected against the disease by eradicating the currants and gooseberries growing within the stand and in a protective border around the stand varying in width up to 900 feet. Often a second and a third working at five to ten-year intervals are required to suppress currant and gooseberry growth.

Constant experimentation is resulting in improved control procedures. In working areas where currant and gooseberry growth is general, three-man crews are being used more and more to replace the five and six-man crews formerly used. Experiments with one-man crews are now under way. Improved procedures for the rapid examination of areas wherein the currant and gooseberry populations are light and localized were developed during the biennium.

At one time or another all the various plant killing chemicals have been tried on currants and gooseberries. Unfortunately, the different species of

Mixed planting of white and scotch pine at St. John's University, Collegeville, Minnesota. This planting made in 1897 is one of the oldest forest plantings in the State. It is protected against blister rust.

currants and gooseberries vary greatly in their susceptibility to any one chemical. For example, in Minnesota, 2, 4-D (2, 4-Dichlorophenoxyacetic Acid) applied as a foliage spray gives a satisfactory kill of only the American black currant. However, a concentrated 2, 4-D solution has proven to be a valuable supplement to the hand pulling of currants and gooseberries.

Often these plants grow in sod or rock where it is difficult to secure the necessary removal of the crowns and larger roots. Breaking or cutting these plants off close to the ground and applying the concentrated 2, 4-D solution to the cut or broken surface gives a satisfactory kill of the portions remaining in the ground. Experimentation is under way using the new compound 2, 4, 5 T (2, 4, 5 Tri-chlorophenoxyacetic Acid) as a foliage spray.

The blister rust control program continues forward at a very satisfactory rate on federal lands. The work on state and private lands is not adequately financed. Table 31 sets forth the control accomplishments in the years 1946 and 1947.

TABLE 31

WHITE PINE BLISTER RUST CONTROL

	Acres White Pine Protected	Acres Worked	Currants and Gooseberries Pulled	Man-Days Expended
Initial Working				
1946	1,839	3,197	888,653	4,278
1947	2,668	3,674	606,600	3,508
Total for Biennium	4,507	6,871	1,495,253	7,786
Total to December 31, 1947	167,395	396,234	61,628,693	161,388
Reworking				
1946	8,189	10,613	531,794	3,792
1947	10,998	15,323	608,659	5,317
Total for Biennium	19,187	25,936	1,140,453	9,109
Total to December 31, 1947	76,789	141,929	8,918,981	49,045

It may be noted that the major portion of work now being done is rework to maintain suppression of currant and gooseberry growth.

Table 32 is a statement of the status of control by ownership as of December 31, 1947. In Minnesota, 266,553 acres of white pine have been selected as valuable enough to justify the cost of blister rust control. To protect this pine acreage it will be necessary to remove currants and gooseberries from 590,866 acres of white pine and protective zones. Initial currant and gooseberry eradication has been done on 373,220 acres to protect 164,866 acres of white pine. Little, if any, additional work will be required to furnish protection to maturity for the 50,160 acres of white pine classified as on maintenance. Of the different ownerships, the U. S. Indian service has its control program the nearest to completion, as over 60 per cent of their pine is on maintenance.

TABLE 32

Status of Blister Rust Control, by Ownerships, December 31, 1947

Ownership Class*	Total Control Problem, Acres**		Acres Initially Worked		Acres on Maintenance***	
	Acres White Pine	Acres To Work	Acres White Pine	Acres Worked	White Pine	Control Area
U. S. F. S.	95,377	157,914	36,787	57,269	10,032	17,453
U. S. I. S.	21,690	32,665	21,670	32,622	12,738	17,557
State Forests	53,873	100,451	31,828	58,126	11,440	20,440
State Parks	4,809	9,087	4,717	8,925	.....	.....
Other State	1,547	10,429	1,358	6,346	835	2,874
Municipal	1,244	3,831	996	2,865	35	80
Private	88,013	276,489	67,510	207,067	15,080	36,078
Totals	266,553	590,866	164,866	373,220	50,160	94,482

*Includes lands within gross boundaries of State, Federal and Indian Forests.

**The Total Control Problem includes only the better stands of white pine.

***A pine area is on maintenance when it requires little, if any, additional currant and gooseberry eradication to prevent commercial damage before it matures.

White Pine pole stand on Cloquet Valley State Forest. Thinned and pruned and examined twice for currant and gooseberry growth by C.C.C. enrollees. Apparently no additional blister rust control work will be necessary.

ACKNOWLEDGMENTS

Without the cooperation of the members of the division's staff who contributed to this report, it would not have been possible to compile it. Without their loyalty and devotion to duty, the work on which they have reported could not have been satisfactorily performed. Grateful acknowledgment is therefore made to the entire personnel of the division for their conscientious efforts during the biennium and for the fine spirit of cooperation and loyalty with which they have performed the work assigned them.

Grateful acknowledgment is also made of the cooperation and assistance given the division by the many agencies, organizations and individuals who contributed so generously of their time and their efforts in furthering the cause of forestry in Minnesota—the Keep Minnesota Green committee, the Forest Industries Information committee, the U. S. Forest Service, the Lake States Forest Experiment Station, and the University of Minnesota Division of Forestry, to mention only a few.

The captions under the pictures on pages 72 and 74 are reversed.


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