UNIVERSITY OF MINNESOTA

DEPARTMENT OF AGRICULTURE

DIVISION OF FORESTRY

The Research Activities of the Cloquet Forest Experiment Station

1928

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Cloquet Forest Experiment Station

University of Minnesota

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During the past few years it has become a practice of the Federal Forest Experiment Stations to prepare and distribute an annual investigative report. This practice has much to recommend it, since it enables investigators and others to inform themselves of the progress made in forest research at these Federal Stations.

Unfortunately, however, the Forest Schools have not adopted this plan and it is now quite impossible, except through direct inquiry, to apprise oneself of the problems studied or the progress being made at such institutions. This brief report of the research work carried on by the Cloquet Forest Experiment Station of the University of Minnesota has been prepared in the belief that the public is interested in results of forest research and that investigators in various parts of the country are to some extent interested in the work carried on in Minnesota. It is hoped that other Forest Schools may see fit to do likewise in order that forest research may be more closely coordinated and expedited.

History of the Cloquet Forest Experiment Station and the Division of Forestry

No exact date can be given for the establishment of the Division of Forestry, University of Minnesota. Like many other educational developments, forest education at Minnesota evolved gradually. In 1881 there was entered into the minutes of the Board of Regents, University of Minnesota, a resolution of great historic interest in forest education. On January 13 of that year, Regent Folwell proposed "that the professor of agriculture be requested to prepare a detailed statement whereby the advantages of a separate and special school of forestry be offered in the Agricultural College of the University". Instruction in forestry actually began in about 1897, but a regular curriculum was not formulated until several years later.

The Cloquet Forest Experiment Station was established through an act of the Minnesota State Legislature on March 31, 1909 to provide a demonstration and experimental forest for the University of Minnesota.

The nucleus around which the Station was formed consisted of 2214.97 acres of land located about four miles southwest of the town of Cloquet and given to the University by the St. Louis River Mercantile Company. In order to round out the boundaries of the area the University later purchased eight Indian allotments, 447.12 acres in area. In 1925, 240 acres of homestead land was purchased. There still remains 40 acres of homestead land within the boundaries of the forest which it is hoped may be purchased soon. The present area of the Station is approximately 2902 acres.

Description

The Cloquet Forest Experiment Station consists of 1881 acres of upland and 1040 acres of swamp, which may be classified as follows:

Class	Approximate Area in Acres	Percentage of Total Area
Jack pine	659	22
Norway pine	156	5
Aspen	224	7
Mixed conifers & hardwoods	276	9
Upland brush	186	6
Plantations and nursery	134	4
Open	290	10
Tamarack	122	4
Spruce	509	17
Balsam	49	2
Alder (lowland brush)	246	8
Muskeg	91	3
Meadow	72	2

These classes are more or less typical for northern Minnesota and the Cloquet Forest area gives, therefore, a good cross-section of the timbered area of the North.

Although the estimate of the amount of timber on the area is subject to revision, present records show that the forest contains 1,860,000 feet of Norway pine, 1,554,000 feet of Jack pine and 125,000 feet of white pine, or a total of 3,539,000 feet of pine saw timber. The total stand by volume and species is given in the following tabulation:

Species	Bd.Ft.	Cu.Ft.	
Norway pine	1,860,000	---	
Jack pine	1,554,000	---	
White pine	125,000	---	
Balsam fir	---	35,000	
White birch	---	97,000	
Cedar	14,000	14,000	(posts)
Spruce	---	137,000	
Aspen	---	58,000	
Tamarack	---	56,000	
Total	3,553,000	383,000	

In addition to the above there are 621,000 cubic feet of wood below merchantable size (7 inches and below) on the Station.

The Cloquet Forest Experiment Station should be particularly interesting to those interested in close utilization. In the town of Cloquet, which is just four miles from the Station, are located lumber mills, a box mill, a paper mill, a toothpick plant, a plant manufacturing wallboard and "Balsam Wool", and a plant manufacturing clothes pins and novelties. These varied industries create a market for forest products which is undoubtedly not excelled anywhere in the United States. In addition, a strong market for firewood exists. Thus the Cloquet Station finds a market for practically all kinds and sizes of wood products.

Organization

The Cloquet Forest Experiment Station is a University enterprise. The support for the Station now comes entirely from University funds, although the Forest Service, U. S. Department of Agriculture, contributed $500.00 annually to the support of the Station until 1915.

When the Lake States Forest Experiment Station was established and located at University Farm, arrangements were made by the University and the Forest Service whereby the director of the Lake States Forest Experiment Station was given a professorship in the University and as such serves as director of the Cloquet Station. This arrangement makes it possible to closely coordinate the research activities of the two stations and avoids unnecessary duplication of effort.

Since the Cloquet Forest Experiment Station represents the investigative activities of the Division of Forestry, it is only natural that the entire staff of the Division participates in the station activities. For the current year the staff of the station is as follows:

W.C.Coffey, M.S. Director M. Ag. Exp. Sta.
Andrew Boss, D.Sc. Vice Director M. Ag. Ex. Sta.
Henry Schmitz, Ph.D. Forester
E.G.Cheyney, A.B. Associate Forester
J.H.Allison, M.F. Associate Forester
Raphael Zon, F.E. Director, Cloquet Forest Ex. Sta.
J.P.Wentling, M.A.* Associate Forester
T.S.Hansen, M.F. Assistant Forester at Cloquet
R.M.Brown, M.F. Assistant Forester
Louis W. Rees, Ph.D. Assistant Forester

The Station is provided with buildings and equipment to care for regular or special investigators wishing to use the research facilities of the Station.

In addition to the Cloquet Forest Experiment Station, the Division of Forestry maintains at Itasca Park the Lake Itasca Forest Biology Station. Itasca Park consists of an area some 30,000 acres in extent and is unusually rich in plant and animal life. The area includes practically every forest type found in the State and both virgin and second growth stands of most of these types. Facilities to care for research workers are found at this Station, which should eventually attract outside investigators interested in forest ecology, forest botany, forest entomology, forest soils, and many other fields.

Active Projects

Although all research carried on by the members of the Division of Forestry staff is supported by the Cloquet Station funds, not all of our research is actually carried on on the Station grounds. Obviously this would be

*On leave 1928-29.

impossible. Broadly speaking, three types of investigations are carried on, namely (1) those at the Station grounds, (2) those made elsewhere in the State, and (3) laboratory and greenhouse investigations at University Farm.

A brief resume of the active investigative projects follows.

INVESTIGATION OF THE DRAINAGE REQUIREMENTS OF SWAMP FOREST GROWTH, OF THE POPULAR TYPE OF DRAINAGE SYSTEM AND THE METHODS AND COSTS OF ITS INSTALLATION AND OPERATION

(Project #101. Joint project with the Division of Agricultural Engineering and the Forest Service, U. S. Department of Agriculture. Leaders: Zon, William Boss, Roe, Schwantes, Gustafson, Schmitz, Hansen).

There are probably about five million acres of swamp forest now existing in Minnesota and probably several million more acres of cut-over or open swamp land better suited to timber raising than to any other purpose, which are not now of great value, but which if properly drained, may develop into profitable forest enterprises. This project has in mind the development and collection of specific data on the influence of drainage on forest growth, the extent and type of drainage that is productive of best methods in tree growth, the cost of installing drainage ditches and other drainage works, and the economic feasibility of such drainage.

It is proposed to select two swamp forest areas of limited extent in the Cloquet Forest for carrying on this work. Careful surveys have been made of these tracts as to topography, soil and sub-soil conditions, existing tree and other plant growth, and the various engineering phases of the problem. This survey, however, showed that the expenses of this project far exceeded the amount of money available, and further work has consequently been held in abeyance. During the summer of 1928 a party has, however, been placed in the field to gather data on the effect of drainage on tree growth in certain swamps which were drained 15 to 18 years ago for agricultural purposes. It is hoped that this data will give some indication of the economic feasibility of swamp drainage for forest purposes.

MANAGEMENT OF THE CLOQUET FOREST

(Project #102. Leaders: Zon and Hansen. Entire forest staff cooperating).

Forest management is the key to the proper handling of the forest. With the exception of the two National Forests within the State, there are practically no forest areas under forest management in Minnesota. If forest owners are to practice forestry there must be some forests under actual forest management as demonstration areas. The Cloquet Forest offers an opportunity for such management and demonstration. For a number of years, data has been collected for the basis of a working plan of the Cloquet Forest. Although not yet completed, the forest has been managed more or less according to a general plan. The out has been held at or below the estimated annual growth. At the same time, an effort has been made to improve the quality of the timber and to improve the growing conditions. The blank areas which have not come up to natural reproduction have been partially planted and it is expected to bring up every acre of forest land to its highest productive capacity. It is estimated that the timber on the Cloquet Forest has a value of approximately $56,000. During the past 12 years the net income from the forest has been $13,329.88, or approximately $1,110 annually. By the time the forest is brought up to its highest productive capacity it is expected to produce 750 cords of pulpwood and 1,125,000 board feet of sawlogs annually.

POSSIBILITIES OF CUT-OVER LAND IN MINNESOTA

(Project #104. Leader: Hansen).

It was originally planned to make a survey of the entire forest area of the State. To date, however, only two counties have been examined, namely St. Louis and Lake. In St. Louis County 103 sections scattered through the cut-over lands were examined. On each section at least two lines were run and on the lines at five-chain intervals 1/10 acre plots were laid out and studied, particular attention being paid to reproduction and blank areas. Using the 103 sections examined as a basis, it was found that of the cut-over lands in St. Louis County at that time 48% were coming in to hardwood reproduction; 24% to mixed reproduction; 11% to conifers; 8% was swamp; 5% muskeg and 4% barren. 78% of all the reproduction fell in the seedling class, 12% in the sapling stage and 10% in the pole stage. The heavy proportion

of seedling stands is due, undoubtedly, to repeated burning.

The species making up the reproduction are different than the original stands. 61% of all the seedling stands are hardwoods (mostly aspen), 55% of all the sapling and 36% of all the pole stands. This seems to indicate that as the stands grow older and escape fires the conifers have a tendency to come back.

In Lake County there have unfortunately been some very extensive and destructive fires since the field data was collected. In this county only 15 sections were examined. Of these, 2% were found to be barren; 2.7% muskeg; 3.9% swamp; 40.9% hardwood reproduction; 26.8% mixed reproduction and 13.9% coniferous reproduction. Comparing these figures with St. Louis County it is evident that there is less barren and a heavier mixed and coniferous reproduction. The reproduction on 79% of all the areas examined were in the seedling stage, approximately 11% in the sapling stage and 10% in the pole stage. Here it is found that hardwoods make up 54% of the seedling stage, 60% of the sapling stage and 20% of the pole stage.

PRESERVATIVE TREATMENT OF FENCE POSTS

(Project #105. Leader: Schmitz).

Over 2500 fence posts of seven different kinds of woods were treated with coal tar and water gas tar creosote and set in the ground at the University Fruit Breeding Farm at Zumbra Heights in 1909. These posts have been carefully examined at more or less regular intervals, the last inspection having been made after 17 years of service. To date, only 12.2% of the posts have been removed on account of decay. About 77% are classified as good and many of these will undoubtedly give at least 5 or 8 years more service. It was found that these creosoted posts have a lower annual maintenance cost than untreated posts of the same wood when a good grade of creosote can be obtained at 30¢ a gallon or less.

STUDIES IN FOREST PLANTING

(Project #106. Leader: T. S. Hansen).

There is a large forest area in northern Minnesota which undoubtedly will have to be planted before it is again brought into a reasonable state of productivity. There were

on the Cloquet Forest Experiment Station a considerable area in need of planting and this has been used to determine experimentally the proper species, the class of stock, the various methods of planting, the best season for planting, and the spacing to use in the establishment of forests by planting. Various species and classes of stock have been planted on the different sites and different seasons, using a variety of spacing and planting methods. Periodic counts and measurements have been made and the results of the 5-year data has been published in Minnesota Agricultural Experiment Station Bulletin 238. The 10-year counts have now all been made and a report of them is being prepared.

THINNING OF JACK AND NORWAY PINE

(Project #107: Leader: Hansen).

Many stands of Jack and mixed Norway and Jack pine grow very slowly because of overstocking. The Cloquet Station contains several such stands. It is important to know how much these stands should be thinned in order to secure maximum volume and quality growth. This will undoubtedly vary somewhat with the age of the stands. Several thinning plots in Jack pine were laid out in 1924. An effort was made to leave 600 trees per acre, but 750 were actually left. There were 2,478 trees per acre before thinning. 69% by number of the trees were removed and 56% of the volume. On another plot, 53% of the trees by number were removed and 33-1/3% of the volume. The results from these plots are still very inconclusive and little stimulation in growth has been noted. In 1913, a thinning plot was established in Norway pine. A report on the 15-year measurements of this plot has been prepared and submitted for publication. In 1927, four 1/10 acre thinning plots were established in a 15-year Norway pine stand. This stand was heavily overstocked. On one of the plots there were more than 20,000 trees per acre. A report of the analysis of this stand has also been prepared and published. It is expected to establish another thinning plot in Jack pine during the coming year.

VOLUME, GROWTH AND YIELD OF BIRCH AND ASPEN IN MINNESOTA

(Project #108. Leaders: Kittredge and Gevorkiantz).

Birch and aspen stands are becoming more important from an economic standpoint. The immense area of these

stands found in the second growth of Minnesota's forest land make them an important factor in future forestry practice. It was therefore found desirable to determine the volume, rate of growth, and yield of aspen and birch, and in general to determine the possibilities of aspen and birch lands. It is estimated that about 2/3 of the forest area of northern Minnesota is now in aspen. In only from 10 to 20 percent of the area is there an appreciable representation of conifers in mixture. The situation is a little different in northeastern Minnesota, where fire protection has been better. Here it is estimated that about 30% of the aspen type has a fair representation of conifers. Volume tables have been completed for aspen of different heights and diameters and in terms of total cubic feet, merchantable cubic feet, cords and board feet, minor Scribner decimal C and International rules. These tables have been published in Technical Bulletin 39 of the Minnesota Agricultural Experiment Station. All of the field work and practically all of the office work on this project has now been completed and the results will be ready for publication sometime during the winter.

WINDBREAK PLANTING INVESTIGATIONS

(Project #109. Leader: Cheyney).

For some years the Division of Forestry has cooperated with farmers in the establishment of demonstration windbreaks. These windbreaks vary in age from 3 to 10 years and afford an excellent opportunity to study (1) the effect of different methods of care in windbreak plantations, (2) the effect of local and seasonal climatic factors on trees planted, (3) to study the comparative value of different species and variety of trees, (4) to study the effect of different methods of trimming and training trees for windbreaks, (5) to determine the species best adapted to windbreak purposes in different sections of the State, (6) to determine at what age or stage of development of a windbreak cultivation may cease, (7) to determine the necessity of thinning a windbreak and if necessary, (8) to determine the most advantageous age for thinning.

Two summers' field work have been done on this study. The data collected thus far indicate a surprisingly uniform rate of growth for each species in all parts of the prairie regions. The differences, where any existed, were insufficient to warrant a classification into zones or regions, nor would there appear to be any difference in hardiness between the northern and southern extremities

of the prairie region. Practically the same group of trees were successful in the same places. There was a much larger percentage of cottonwood in the north in the few places where they had been planted as they were in the south.

The soil moisture in the first and second foot differed only with the time which had elapsed since the last rain. It was uniformily higher outside the plantation than inside, but nowhere was this difference very great. As might be expected, the humidity was higher inside the plantation than outside.

The second year's work brought out a few additional facts. The growth of a young plantation was found to be almost wholly proportional to the degree of care and cultivation which it enjoyed. Jack pine gives promise of being the most satisfactory coniferous species for windbreak planting. There were very few places where plantings which had been taken care of were not a success. All the field data are now collected and it is hoped to complete this project during the winter.

STUDIES IN YIELD AND VOLUME

(Project #110. Leader: Allison).

The solution to many problems in forest management can only be found by prolonged study of an extended series of permanent sample plots covering both artificially and naturally reforested areas located on different soils and including all of the available species. A number of sample plots have been made out at the Grand Rapids Sub-station, in the Lake Vadnais plantations, on the Cloquet Forest Experiment Station, at the Lake Itasca Forest Biology Station and elsewhere. Growth measurements have been made on these plots from time to time and several progress reports have been published. Since the last progress report was published, survival counts were made on several new planting areas in the Lake Vadnais plantations. These survival counts indicate that under several drought conditions a survival of Norway pine upon similar sites will be much higher if planted in furrows plowed in the sod than if planted in the sod itself.

Considerable winter injury occurred in the Norway pine in these plantations during December, 1927. Here the snow dirfted deeply and was largely converted into ice by a thaw early in 1928, remaining in that condition

until March. This caused considerable damage to the Norway pine transplants which had their leaders broken by the snow. This damage was largely confined to the most vigorous trees and those leaders which had made a height growth of from six to eight inches. Approximately 50% of the Norway pine trees on one plot were damaged in this way.

The summer of 1927 was very favorable and the losses in the new plantations due to weather conditions were small for all species. During the summer of 1928 the permanent sample plots at the Grand Rapids sub-station and the Lake Itasca Forest Biology Station will be measured.

WORKING PLAN FOR THE CLOQUET FOREST AREA

(Project #111. Leader: Allison).

The object for this project is to prepare a working plan for the forests of the Cloquet Forest Experiment Station that it may be managed systematically and developed into a model forest. To data, field maps (by 40s) have been completed, the trees on the entire area have been calipered and all volumes have been computed, tabulated and totalled. These calculations indicate that there are 3,553,000 feet board measure of saw timber, 1,550 cords of balsam and fir pulpwood and 150 cords of aspen and birch. These estimates do not include the tamarack, most of which is dead. The data on the 40 maps has been transferred to a large base map (16" to the mile) of the Station property. This map shows the exact location and area covered by each stand on the Station. The various stands have also been classified. The making of this map proved to be a very time consuming operation, due to the variety and irregularity of the stands on the Station area. A preliminary draft of the working plan will be completed during the winter of 1928.

BLACK SPRUCE VOLUME STUDY

(Project #113. Leader: Brown).

Black spruce is one of the important pulpwoods of Minnesota and the Lake States region. Peculiarly enough, no volume tables or cordwood converting factors based on data collected in Minnesota are available for this species.

The harvesting of a black spruce stand on the Cloquet Forest Experiment Station offered an excellent opportunity for the collection of such data as are necessary for compiling a set of the standard, cubic foot and cordwood volume tables for black spruce. The number of cubic feet per standard cord for the purpose of converting cubic feet to volume tables for cords was also determined. These tables have been prepared and will be published during the winter of 1928. The Lake States Forest Experiment Station is cooperating in the preparation of these tables.

A STUDY OF THE ECONOMIC MANAGEMENT OF THE FARM WOODLOT

(Project #114. Leaders: Allison, Schmitz, Hansen (in consultation with Divisions of Agricultural Economics, Farm Management and Extension).

Over much of the State not all of the land within the present or prospective farms can be utilizad properly for the production of agricultural crops. One of the more important problems which agriculture faces today is finding a substitute use for the idle, unproductive lands within and surrounding the farms, together with that portion of the land now under cultivation, the product of which cannot be profitably marketed. The problem here to be studied is the possibility of substituting a forest crop for field crops wherever the former offers prospective returns greater than that offered by the latter.

All available information dealing with the economic aspects if the farm woodlot has been examined and abstracted. The data collected by Dr. John Black pertaining to selected farms located within the cut-over region of Northeastern Minnesota were studied carefully and all data pertaining to farm woodlots and income from working in the "woods" were abstracted. After carefully analyzing the above material, a schedule was prepared which will be used in the field for collecting desired information.

There are several millions of acres of poor quality oak stands included in the farm woodlots in Minnesota. These are found principally between the coniferous region in the northeast and the prairies in the west and southwest. Considerable work was done during the year in studying coniferous plantations already established on such oak areas. It is important to know what are the possibilities of

converting these poor qualities of oak stands into much more productive and valuable coniferous stands. This work involved making survival counts upon plantations established within the last five years. Height and diameter measurements were also made on these plantations. The soil upon which these plantations have been made has been classified by the Division of Soils. Hence the plantations located upon such soils can be used as a standard in estimating what other plantations on similar soils will probably do.

Considerable areas of cut-over lands, particularly in Clearwater, Hubbard, Cass, Crow Wing and Carlton counties have come into jack pine by natural seeding. A considerable portion of jack pine lands is included within farms. Several sample plots, the purpose of which is to determine how these stands should be managed to get the best results, have been established. One of the most important considerations in the management of the farm woodlot is the renewal of the stand either by natural or artificial methods. Because of the lack of any definite plan of management, the woodlots on a large number of farms have deteriorated in quality. It is necessary, therefore, to determine how the woodlot can be improved in a program of planting. The planting studies at the Cloquet Station, some of which have now run over a period of fifteen years, are yielding valuable results in this connection. These studies show the best species to use on the various types of land in the Northeast and the age class that gives the best results. Records have been kept of the efficiency of different methods of planting. The growth of different age classes of stock has been studied and it has been found that there is reason to believe that 2-2 stock is more desirable than the cheaper classes of planting stock.

It has also been found necessary to study the condition of the cut-over lands with respect to the second-growth. New farms are and will be established in the cut-over area and the wood crop will undoubtedly be an important source of income, at least during the earlier years of these farms. New woodlots will be created and existing woodlots will be extended. The character of the stands of second growth, or its absence, will have a bearing on the value of these woodlots and farm lands. A survey of these lands shows that somewhat less than five percent is barren and the balance of the land is in some type of forest growth.

Since the use of land is largely determined on its productive capacity, it is important to know how farm land is utilized before the place of the woodlot can be definitely determined. The census figures have been analyzed for each county in the state and for groups of counties showing the progress in clearing and cultivating land. The proportion of the total farm area which is in woodlots has also been determined. Even in the most settled portion of the state the woodlot and unimproved portion of the average farm represents approximately 25 per cent of the total area.

During the latter part of the summer of 1928 two men have been collecting field data in the southeastern and central portions of the State. This data will be worked up during the coming winter.

THE RELATION BETWEEN THE SPECIFIC GRAVITY AND PULP YIELD IN PARTIALLY DECAYED ASPEN WOOD

(Project #115. In co-operation with Agricultural Biochemistry. Leaders: Schmitz and Franke).

It is a known fact that certain wood-destroying fungi have a preference for certain wood constituents, for example: some fungi primarily break down the lignin and but slightly affect the cellulose of wood. Other fungi in their growth and metabolism may dissolve the cellulose almost completely and cause but slight change in the lignin content. This is a very important consideration from the point of view of the manufacturer of chemical wood pulp from partially decayed wood.

Aspen is at present one of the most widely distributed trees in Minnesota and is destined to become one of the most important by mere virtue of the fact that it is very widely distributed.

Aspen is now used for pulpwood. There is also every liklihood that this use will increase. Furthermore, it is not an exaggeration of the fact to say that utilization of aspen in Minnesota presents one of the most important forest problems in the State. It is also quite extensively used for box shooks and excelsior. These uses are probably secondary to its use as pulpwood. Since the utilization of aspen as pulpwood is an established fact, and since the finding of an important use for this material will help materially to make forestry practice in Minnesota possible, it logically follows that any factor affecting the utilization

of aspen as a pulping material is of great concern. The heart rot, so universally found in aspen, is such a factor and is worthy of study.

The specific gravity of some 200 samples of normal and decayed aspen wood have been determined. These have been ground and are ready for chemical analysis. Aspen wood has also been allowed to decay through the action of the wood destroying fungus Lenzites seapiaria under controlled conditions. Samples of decayed sawdust which have been acted upon by the fungus for periods varying between two and twenty-eight weeks are now also available for chemical analysis.

A STUDY OF HAZEL AND ALDER BRUSH IN RELATION TO REPRODUCTION

(Project #116. Leader: Cheyney).

Throughout extensive areas in northern Minnesota there is a tendency for land to grow up to dense thickets of alder and hazel. This brush occurs not only on cut-over lands, but also in dense stands of timber, particularly in thin stands of mixed white and Norway pine. When such stands are cut the brush often monopolizes the land to the exclusion of all tree growth. Fire seems only to increase the density of the brush. All attempts to plant such land have failed. Natural reproduction seems to force its way in time, but the process is slow, requiring many years. This tendency of the brush to take possession of the land is one of the most difficult problems of the silviculturist. During the field season of 1928, a series of experimental plots were laid out, designed to determine the conditions under which the brush thrives, the conditions of brush cover under which seedling conifers can grow, and practical methods of systematizing reproduction on lands already densely occupied by brush. The field data which have been collected have not yet been analyzed.

THE VALUE OF "TREATER DUST" AS A WOOD PRESERVATIVE, PARTICULARLY FOR FENCE POSTS AND POLES

(Project #117. Leader: Schmitz).

Treater Dust is a wood preservative recently put on the market by the Anaconda Copper Mining Company. As far as it is possible to learn, this substance is composed

largely of arsenic compounds. The material is comparatively cheap and many claims have been made for it. If these claims are true, then this product will undoubtedly have a rather profound influence on the methods now used in the preservative treatment of posts and poles.

During the past field season jack pine, aspen and cedar posts treated with "Treater Dust" at the rate of 1½ pounds per post were set at the Cloquet Forest Experiment Station in sandy soil. Untreated posts of the same species were also set at the same time and under the same conditions. These posts will be examined annually and differences in their resistance to decay will be noted.

NORMAL YIELDS OF RED AND WHITE PINE IN MINNESOTA

(Project #118. Leader: Brown).

Red and white pine are generally considered to be the two leading soft wood trees in Minnesota, due chiefly to the characteristics of the wood and the rapidity with which it is produced. Furthermore, immature stands of these species occur in many parts of Minnesota. For these reasons it can be expected that they will receive considerable attention in any State Forest policy. It is necessary, therefore, to obtain reliable growth and yield data for both white and red pine. This project was initiated during the field season of 1928. Although numerous small areas of these species were examined, comparatively few were large enough for study. So far, 30 plots most of which are white pine, have been laid out and studied. The maximum age of the trees on these plots is approximately 60 years. Suitable stands of the older age classes are extremely rare. Indications are that it will require another season's field work before sufficient data are available.

WOOD UTILIZATION IN SOUTHERN MINNESOTA

(Project #119. Leader: Rees).

Approximately 25% of the southeastern section of Minnesota is in woodlots. Many of these woodlots have been severely cut-over for a great number of years and in some cases only inferior grades of timber remain. The utilization of this material is a very serious problem con-

fronting the woodlot owner. This study proposes to control data on the needs of the wood-using industries in southern Minnesota in order to determine (1) the markets for local growing wood products, (2) the extent to which wood-using industries depend upon local supply for wood material, (3) the amount and type of material secured outside of the State. Having such information available will enable us to advise woodlot owners as to the most desirable species to plant from the standpoint of utilization and economic value. The field data on this project were collected during the field season of 1928, but have not yet been analyzed.

Publications

In considering the number of publications prepared by members of the Cloquet Forest Experiment Station Staff it must be borne in mind that by far the greater part of their time is devoted to teaching. Since the reorganization of the Division of Forestry in 1925, however, teaching schedules have been so arranged that every member of the staff has some, even though it be limited, time which may be devoted to research. During the past three years the number and importance of publications has steadily increased and will continue to increase in the future.

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Cheyney, E.G. and Corson, C.W. Injury by rabbits to coniferous reproduction. Jour. Forestry 26: 539-543. 1928.

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Cheyney, E.G. What tree is that? 184 p. New York.

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Kribs, D.A. Tracheids in Jack pine in relation to their position in the vertical and horizontal axis of the tree.

Wentling, J.P. The wood of a cedar pole. Telephone Engineer.

Numerous reviews and abstracts prepared by the staff during the year are not included in the above list.

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