THE AMES FORESTER

Published Annually by

The Forestry Club

of

Iowa State College

Ames, Iowa

GEORGE B. HARTMAN, Editor in Chief
EDWARD M. DAVIS, Associate Editor
R. A. FLETCHER, Business Manager
V. B. HOTER, Assistant Business Manager
PATRONS

A. L. Bakke
S. A. Beach
H. F. Brown
H. H. Cornell
C. F. Curtiss
W. P. Harley
L. E. Hicks
C. H. Ineck
D. H. Isch
G. B. MacDonald
G. C. Morbeck
L. H. Pammel
T. R. Truax

Credit for the financial success of this publication is due in a large measure to the patrons.
G. B. Mac Donald

To
G. B. MacDonald,
who thru his intense interest in better forestry, has made the course at Iowa State College what it now is, and who thru his earnestness and kindliness, has won the esteem of all who know him, we, the Forestry Club, respectfully dedicate this publication.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Philippine Forests</td>
<td>M. L. Merritt, U. S. Forest Service, Portland, Oregon</td>
<td>5</td>
</tr>
<tr>
<td>Seed Vitality as a Factor in Determining Forest Types</td>
<td>J. V. Hofmann, U. S. Forest Service, Washington, D. C.</td>
<td>13</td>
</tr>
<tr>
<td>Utilization of Wood Waste</td>
<td>Carl A. Kupfer, Forest Examiner, San Francisco, California</td>
<td>17</td>
</tr>
<tr>
<td>The Stumpage Situation in the Pacific Northwest</td>
<td>G. C. Morbeck, Associate Professor, Iowa State College</td>
<td>22</td>
</tr>
<tr>
<td>Planting Trees on Kansas Prairies</td>
<td>L. T. Bode, in charge of Nursery, Fort Hays, Kansas</td>
<td>28</td>
</tr>
<tr>
<td>Scaling and Check Scaling in the U. S. Indian Service</td>
<td>Ralph W. Hayes, U. S. Indian Service, Ashland, Wisconsin</td>
<td>33</td>
</tr>
<tr>
<td>The Flora of Lake Vermillion</td>
<td>L. H. Pam, mel, Professor of Botany, Iowa State College</td>
<td>40</td>
</tr>
<tr>
<td>A Summer's Work on a Forest Service Experiment Station</td>
<td>Allen S. Henry, Class '17, Iowa State College</td>
<td>50</td>
</tr>
<tr>
<td>Directory of Forestry Alumni</td>
<td></td>
<td>54</td>
</tr>
<tr>
<td>Seven Thousand Miles with Ames Foresters</td>
<td>G. B. MacDonald, Professor of Forestry, Iowa State College</td>
<td>57</td>
</tr>
</tbody>
</table>
The Philippine Forests

M. L. MERRITT, B. S. F.
U. S. Forest Service, Portland, Oregon.

Unlike the forests of a temperate region, where in a single locality the number of tree species usually does not exceed 10 or a score, those of the Philippine Islands, and probably of any tropical country, contain a bewildering number and variety. In one locality where an actual count was made, 80 different species were collected on a single acre. While this is likely extreme, almost any acre in a virgin stand would probably contain a score of different kinds. Altogether it is estimated that there are more than 2,500 different tree species in the Islands. Many of these, however, are not large growing sorts. As a matter of fact, probably not more than 600 or 700 reach saw timber size when mature. Of those, only something over 100 different species commonly find their way into the markets as lumber.

It is popularly supposed also among those not familiar with the situation that tropical forests are made up principally of species producing cabinet woods, such as mahogany, rosewood, etc. While such kinds occur frequently, they very seldom constitute the bulk of the stand. In fact the real timber wealth of the Islands lies not in cabinet woods but in ordinary construction timbers, the great majority of which belong to a single botanical family—dipterocarpaceae. The dipterocarps, as they have been called, are as important to the Philippines from a timber standpoint as are the conifers to the United States. There are many different kinds of them represented in the family, probably as many or more as there are conifers in this country. Some produce hard durable woods while others are soft and easily worked. Many of them take an excellent finish so that when stained they are splendid cabinet woods. Practically all are large growing kinds, reaching heights of 130 to 190 feet and diameters of 40 to 60 inches, frequently much more. As a class they have straight regular boles often free of limbs for 100 feet. It can thus be seen that although botanically exceedingly complex, the forests from a commercial standpoint are not quite so confusing as would at first appear. In fact, when one has learned to recognize the dipterocarps in the woods, together with a number of other principal commercial species, it is surprising to know how large a per cent of the trees in a virgin forest are familiar to him.

A better idea of the general composition of the forests in general is afforded by a concrete illustration. On the Island of Mindoro, where the writer spent over two years, there were collected 552 different species. Of these, approximately 49%
THE AMES FORESTER

reached when mature a diameter of 12 inches and a height of 40 feet or more; 32% were smaller than the above but over eight inches in diameter and 26 feet in height. The remaining 19% were smaller than the above although still with distinct tree forms. Of the total 552 species but 13 were dipterocarps. Undoubtedly this represents less than one-half the total number of species on the Island, but probably the proportions of different sized trees that occur is representative.

Before describing the forests further the following general facts are given concerning the Islands, so as to make clearer one’s understanding of the situation. The Philippines lie between 5 and 21 degrees north latitude, about directly south of the east coast of China. The group consists of 11 large and about 2,000 small islands. All of the large islands, and many of the small ones, are mountainous with ranges generally extending in northerly and southerly directions. These commonly reach elevations of 3,000 feet or more above sea level, the highest points being over 10,000 feet.

Aside from the continuous warm weather, the outstanding climatic feature so far as its effect on vegetation is concerned is rainfall. The distribution of this is governed mostly by the direction of the prevailing winds, or the monsoons as they are called. From November to May the prevailing winds are from the northeast, during which period most of the rainfall is on the eastern or Pacific side of the islands. During this time the western portion of the territory, which comprises the greater bulk of the area and supports the largest part of the population, has a dry season. During the other monsoon the moist southwest winds striking the western coasts bring the wet season. The rainfall varies greatly from place to place, depending upon the effect of mountain ranges and other factors, ranging from 36 to 160 inches. Generally the precipitation is between 60 and 90 inches, most of which falls during the wet season between June and October.

The population is confined mostly to the sea coasts and to a few of the larger valleys, there being few people back in the mountainous areas where the virgin forests occur. Those living in such regions are practically all of the non-Christian tribes, the coastal population belonging to different so-called Christian tribes. In the zone between the settlements and the virgin forests are frequently large areas of grassland or of second growth timber, practically all of which represent areas that were once in forest but which have been cleared and cultivated and then abandoned.

The following tabulated statement gives approximately the area of land by classes:

<table>
<thead>
<tr>
<th>Class of vegetation</th>
<th>Area in square miles</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virgin forest</td>
<td>40,000</td>
<td>33 1-3</td>
</tr>
<tr>
<td>Second growth forest</td>
<td>20,000</td>
<td>16 2-3</td>
</tr>
<tr>
<td>Grassland</td>
<td>48,000</td>
<td>40</td>
</tr>
<tr>
<td>Cultivated land</td>
<td>12,000</td>
<td>10</td>
</tr>
</tbody>
</table>

**Total** ........................................ 120,000 100
Native village, showing arrangement and construction of houses. The poinls in center are young cocconuts.

Native canoes or "bancas" as they are called. These are fitted with outriggers to prevent their upsetting.
Of the cultivated land probably not over one-half is cultivated during any single year. Of the grassland the larger percentage of area is not being utilized for any purpose.

Practically all of the timbered area of the Islands, both virgin and second growth forests, are still in public ownership and as such are under the direction and management of the Philippine Bureau of Forestry. The virgin forests are of chief interest since they contain practically all of the present stand of commercial timber. There are several more or less distinct types occurring in approximately the following proportions and containing about the quantities of timber shown in the following tabulated statement:

<table>
<thead>
<tr>
<th>Type</th>
<th>Per cent</th>
<th>Square miles</th>
<th>Acres</th>
<th>Estimated volume of standing timber (million board feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipterocarp</td>
<td>75</td>
<td>20,000</td>
<td>19,200,000</td>
<td>192,000</td>
</tr>
<tr>
<td>Molave</td>
<td>10</td>
<td>4,000</td>
<td>2,560,000</td>
<td>7,680</td>
</tr>
<tr>
<td>Pine</td>
<td>5</td>
<td>2,000</td>
<td>1,280,000</td>
<td>2,560</td>
</tr>
<tr>
<td>Mangrove</td>
<td>2</td>
<td>800</td>
<td>512,000</td>
<td>1,024</td>
</tr>
<tr>
<td>Mossy</td>
<td>8</td>
<td>3,200</td>
<td>2,048,000</td>
<td>Protective</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>40,000</strong></td>
<td><strong>25,600,000</strong></td>
<td><strong>203,254</strong></td>
</tr>
</tbody>
</table>

As already stated, the dipterocarps are the predominating tree species. The forests in which they occur have been called the dipterocarp type. In this type are many sub-types, depending on composition which in turn is determined by the various factors of the environment. In general, however, the dipterocarp forest occupies the regions where growing conditions are most favorable. These vary topographically from moist river bottoms to hilly and mountainous country. In composition the dipterocarp type generally is very complex. First are the large dominant trees, among which various species of dipterocarps are generally most common. There are, however, a great variety of other large growing sorts which add to the complexity of the forest, but many of which kinds have never yet been utilized commercially and some of which have little apparent value. Under this upper story of dominant trees, which often does not occupy the entire area, is an understory of small sub-dominant ones of great variety but generally of minor importance from a commercial standpoint. Still below the sub-dominant trees are the smaller kinds of tree species and a heavy growth of herbs and shrubs. Although these latter always grow in the greatest profusion as compared with forests in temperate regions, they are relatively fewer where the stand of timber is dense. Over and through the whole mass of trees, shrubs and herbs is almost invariably a tangle of vines. Always present as a major element in their composition are several species of climbing palms or rattans, some of which produce the rattans of commerce. Although the diameter of these rattans is small, varying from one-half to 2 inches, they grow to great length,
probably 300 or 400 yards or more. At any rate they reach to the tops of the highest trees and make tangles of growth in the openings that are almost impenetrable. Their long palm-like leaves are armed with strong recurved spines which if caught in one's clothing will bring you to a sudden halt. In many places also climbing bamboo occurs in the openings and forms an even more impenetrable mass than do the rattans.

The quantity of timber per acre varies, of course, with the site and the composition of the forest. The following tabulated statement, based on averages of different tracts that have been examined in different localities, will give an idea of the quantity of timber in trees over 16 inches in diameter that occur in a number of localities:

<table>
<thead>
<tr>
<th>Location</th>
<th>Feet B. M. per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Negros (Low hill forest)</td>
<td></td>
</tr>
<tr>
<td>Dipterocarps (6 species)</td>
<td>42,900</td>
</tr>
<tr>
<td>All other species</td>
<td>2,300</td>
</tr>
<tr>
<td>Total</td>
<td>45,200</td>
</tr>
<tr>
<td>Eastern Mindoro (River Plain)</td>
<td></td>
</tr>
<tr>
<td>Dipterocarps (4 species)</td>
<td>9,400</td>
</tr>
<tr>
<td>All other species</td>
<td>6,900</td>
</tr>
<tr>
<td>Total</td>
<td>16,300</td>
</tr>
<tr>
<td>Mindanao Island</td>
<td></td>
</tr>
<tr>
<td>Dipterocarps (10 species)</td>
<td>13,600</td>
</tr>
<tr>
<td>All other species</td>
<td>15,300</td>
</tr>
<tr>
<td>Total</td>
<td>28,900</td>
</tr>
<tr>
<td>Bataan Province (Hilly to mountainous)</td>
<td></td>
</tr>
<tr>
<td>Dipterocarps (6 species)</td>
<td>19,600</td>
</tr>
<tr>
<td>All other species</td>
<td>8,900</td>
</tr>
<tr>
<td>Total</td>
<td>28,500</td>
</tr>
</tbody>
</table>

The molave type is so called because molave (*vitex parviflora*), one of the hardest and most durable woods which the Islands produce, is a characteristic tree. This type occupies the drier sites, generally the lower hills where growing conditions are not so favorable for the development of heavy stands of dipterocarps. The forest is much more open than in the previous type and the larger trees are farther apart, shorter and more irregular in form although some of them are among the most valuable species which occur. Between the larger trees is the characteristic under-story of smaller ones and through the whole a profusion of vines in which the climbing bamboos often predominate. The stand per acre in this type of timber is small as compared with the previous one, averaging not more than 3,000 feet B. M. per acre with maximum stands perhaps 3 or 4 times as large. The commercial value of this type, however, is greater than would at first appear, since many of the trees are splendid cabinet woods which bring the highest market prices and also because this type of forest is apt to grow in the more accessible regions so that the cost of exploitation is relatively low.

The mangrove type grows on tide flats, at the mouths of streams and on the shores of protected bays, in fact practically
Interior of virgin dipterocarp forest. The large trees are dipterocarps. Note the man in the foreground almost obscured by the mass of herbs and shrubs.
THE PHILIPPINE FORESTS

everywhere that tide water covers the land except on exposed beaches. Frequently these tide flats are a mile or more in width. In composition these forests are very simple, the majority of the stand belonging to a single family—rhizophoraceae. Frequently some of the different species occur in pure stands, although generally there are a half dozen or so mixed together. Nearly all of them are relatively small growing kinds in normal mature stands ranging from 6 inches to 30 inches in diameter and from 40 to 50 feet in height. There is relatively little undergrowth except near the upper limits of tidewater where this type mingles with fresh water ones. These mangrove swamp forests produce great quantities of fire wood, while the bark of many species is gathered as tan bark. In addition to the trees described above, a palm known locally as "nipa" grows along streams in many parts of the tide flats. The leaves of the nipa palm are one of the most important products of the Islands to the natives, since they are used almost exclusively for thatching roofs and sides of the native houses.

The beach type of forest grows on sandy beaches and beach flats lying above high water. The stand is very complex, containing a great many species, but the type is not especially valuable.

The pine type of forest occupies the high mountainous region of northern Luzon, nearly all of which is over 3,000 feet in elevation. Throughout this region pine (pinus insularis) grows in nearly pure stands. Occasionally these are dense, running up to 10,000 or 20,000 feet per acre, but more often they are very open and scattered. In the pure stands of pine there is very little undergrowth except grass and ferns. Strange to say, the common fern growing in this region belongs to the same genus as does the brake fern so common in portions of the United States. In the stream bottoms and on the moister slopes broad-leaved species occur, often forming dense jungles not unlike that in other forest types. In general appearance the open pine forests are not greatly different from the yellow pine forests in the western United States. The trees grow to large size and produce a fair grade of timber which is rather inclined to be pitchy. This type of forest is practically the only one which is liable to be killed by forest fires. The grass, which during the wet season grows in great profusion, dries out in the dry part of the year and with the needles that have accumulated, burns fiercely, doing great damage to reproduction and often to mature trees. Apparently it is the forest fires that have prevented the pine from producing dense stands. With fire protection the region would probably support a fairly uniform and heavy stand of timber, possibly 15,000 or 20,000 feet B. M. per acre. Scattered pine trees are also found in two other localities aside from the mountainous area of northern Luzon—one in
Zambales and the other on Mindoro Island. In both of these latter areas there is also another species of pine found in addition to the one growing farther north.

The mossy type of forest, or the mountain type, as it might be called, is a purely noncommercial one, occupying the higher mountain tops all over the Islands. Most of the trees are small in size, although there is still a dominant and sub-dominant story. There are, however, fewer vines although still a large amount of undergrowth. The outstanding feature of the forest is the ever present covering of moss. This grows on all the branches and trunks of trees and shrubs, so that stems an inch or 2 inches in diameter are often so covered with moss that they appear to be 5 or 6 inches in diameter or more. Sometimes the moss hangs in long tendrils from the branches and in turn is covered with ferns and orchids, so that taken as a whole this type of timber is by far the most beautiful of any on the Islands. Among the tree species which occur are species of ash, maple, yew, barberry, oaks and several other temperate zone species. In the herbaceous growth also are a great many familiar plants in which are a number of species of violets and a wild rose. Here also ferns develop into definite tree forms which are found nowhere else.

In the foregoing discussion little mention has been made of palm trees. There are a great many different species of these which are very numerous in some localities, especially in the dipterocarp type of timber. Usually they occur scattered with the other trees, although in a few instances in pure stands on areas of a few acres each. As a whole, however, palms constitute a minor part of the forest.

The above discussion gives a general idea of the composition of the forests themselves, and now a word regarding some of the commoner animals which are found in it. Just as favorable growing conditions produce a profusion of vegetation, so does the favorable climate often develop an abundant fauna. Among the larger animals are wild pigs, deer, wild buffalo and occasionally monkeys. The former are widely distributed and in places are very numerous. It is very usual to see them scurrying out of the way as one comes near. They are of the razor-back type, sometimes reaching 200 or 300 pounds each in weight. They live on fruit and vegetables found in the forest and afford very excellent meat. Deer are not so widely distributed as are pigs, but are numerous in the more open places and especially in grassy areas away from settlements. There are several species—all good food. Wild buffalo (carabao), while not widely distributed, roam in large herds in a few of the unsettled regions, especially along the flat plains of the larger rivers where quantities of natural forage is produced. These probably are not native but have developed from animals which have escaped from civiliza-
Mangrove swamp showing high stilts roots of one of Rhizophora.
tion. In Mindoro Island is a native buffalo (*tamarao*) found nowhere else. These animals are said by the natives to be very ferocious and to charge a man on sight. Although the writer has known of several instances where men were injured by them, he has never seen one alive, although several months were spent in the territory in which they are found and many of their trails were followed. Probably their ferocity is greatly exaggerated by the natives. Monkeys occur in groups in some regions, generally near settlements.

Bird life is abundant, although one is rather disappointed that there are not more species with brilliant plumage. Among the different kinds are wild chickens which are found practically everywhere throughout the woods at the lower elevations. These chickens resemble the domestic game chickens that are raised in this country and are a food much prized by the natives.

Land travel throughout the Islands is slow and methods are very primitive. Most of it is done on foot, although in some places one can secure little native horses, which although not very much bigger than a man, are able to carry you along the sandy beaches or trails through the woods with apparent ease. The sandy beaches are the commonest route of travel in the less settled regions, being the main thoroughfares between the scattered villages which are all located on the seashore. Outside of Manila and a very few of the larger towns, there are no hotels whatever, so that one always stops at private houses unless in the woods. The people, however, are very hospitable and often inconvenience themselves greatly to care for visitors.

For food rice is everywhere the staple, potatoes and flour being very seldom obtainable. For meats fish is most often used, the natives drying fish and taking it with them on trips, or keeping it for a reserve supply. In villages chickens and eggs can generally be had. Bananas are found in most places during practically all seasons of the year, but other fruits are not common except for relatively short seasons. In addition to these and a few other articles which one can secure from the natives, an American traveling in the Islands generally takes with him a supply of canned goods.

These are a few of the conditions which an American forester meets in the Islands. At best life is hard. One could recount obstacles and difficulties almost without end. There is the possibility of sickness away from medical attention and in a country where disease develops rapidly. The torrential rains frequently swell small streams to the size of rivers and makes fording them dangerous. Similarly, the tides raise the water in small streams which at low tide are fordable, so that one can only sit and wait for the water to go down. Often the American forester has to spend weeks or months away from his fellow white man, sometimes away from mail communication. But with all its drawbacks,
the life is most fascinating and interesting. In few places is such an opportunity offered one to explore, map and describe unknown regions. Everywhere are strange trees, new plants and unusual surroundings. The extremely favorable growing conditions and the large variety of plant life afford one an opportunity to study ecology which is unexcelled, and the mere living among a different race and associating with them, as must a forester traveling through their country, cannot help but give him a broader grasp of their life problems and more sympathy with those who happen to be born into a less favorable environment than our own.
My outfit on a field trip. The two larger natives are full grown, being representatives of one of the mountain tribes—the Mangyans.

Windswept trees at summit of highest mountains.
Seed Vitality as a Factor in Determining Forest Types

J. V. HOFMANN, M. F. PH. D.
In Charge of Wind River Experiment Station, U. S. Forest Service.

How many people, including foresters, when expressing admiration of a tree, ever think of the adverse conditions which that tree has had to overcome in order to attain its present graceful or magnificent form? These adverse factors are met in artificial reforestation yet the forester is able to establish thrifty forests where nature has failed. This success is accomplished by the use of methods which nature cannot supply, such as planting a tree two or three years old, thereby eliminating all the factors which mean failure during the seedling stage. Thus it is within the realm of the forester to improve on nature's methods in tree production the same as this end has been accomplished in many other activities of man. Just as in the natural state, the eggs of the shad fish produce about 2 fish out of every possible million while man has insured a success of 70%, so is nature producing millions of tree seeds where a very small percent or none produce trees. It is the endeavor of this article to give some of the reasons for nature's apparent wasteful methods and to show how these facts, when known, may be utilized by the forester.

The limitations of forest types as the forest gradually or abruptly gives way to prairie, or the clearly drawn lines along ridges where one type occupies the north and east slopes and another the south and west, or the definitely drawn lines within the forest have been the subject of much discussion and conjecture. At the present time soil temperature and soil moisture are conceded to be the controlling factors in these limitations of species. While these no doubt are very important and influential factors the seed and its characteristics, of the species concerned, must not be overlooked, because, after all, the controlling unit of any species is the ability of its seed to perpetuate the species.

The presence of any species on an area is prima facie evidence of the 4 principal chapters in the establishment of a forest, viz:

Seed production.
Seed distribution.
Seed germinability.
Seedling establishment.

Since these stages are distinct and consecutive they may best be considered consecutively.
SEED PRODUCTION.

The production of seed in any type has not been found to be a limiting factor in determining type except in very special and extraordinary cases. Any forest type produces sufficient quantities of seed and at short enough intervals to insure a perpetuation of the type providing other factors are favorable. The variations of seed production may, however, have some bearing on limitations of species. Some species, such as hemlock and cedar, produce almost annual crops of seed and thereby provide a constant supply of seed and are ready to take advantage of all favorable seasons for establishment while species producing seed at more or less periodical intervals, as western white pine, Douglas fir, and others may miss favorable seasons of establishment through a lack of seed.

SEED DISTRIBUTION.

The distribution of forest tree seeds depends to a great extent on the local conditions, such as topography, wind, rodents, etc.; and perhaps even to a greater degree on the nature of the seed itself. Heavy seeds as western yellow pine and western white pine are usually carried only a short distance by wind, seldom exceeding 5 to 6 chains, while lighter seeds as western red cedar and western hemlock may be carried farther.

Where the forest type changes abruptly from a Douglas fir-cedar-hemlock type on the north and east slopes to a yellow pine type on the south and west slopes, as occurs in Idaho and Oregon, the determining factor very clearly is not seed distribution. The location of seed-bearing trees of all these species would insure seed of all species being distributed over large parts of the areas covered by very distinct types, yet some of the species do not appear at all in the stand although the presence of seed is assured.

SEED GERMINABILITY.

The foregoing discussion has shown that the presence of seed alone on an area does not insure the appearance of the species nor does this factor alone determine type limitations, however, in this same connection the germinability of the seed is important. When white pine, Douglas fir, hemlock, yellow pine and cedar are in competition the seed of each species may be present at the same time, but the varying periods required for germination, under favorable conditions, give the advantage to the species which germinate quickly, such as hemlock and cedar and may result in the suppression of the dilatory Douglas fir and white pine. In some instances the disadvantages of delayed germination are offset by the ability to overcome competition by faster growth during establishment. This character has enabled the white pine and Douglas fir to be successful competitors of hemlock and cedar on sites favorable to all of these species. The
short period required for germination of yellow pine when conditions are favorable is its greatest asset in gaining possession of severe sites or maintaining itself on such sites. If in the spring there is a period of favorable moisture and temperature for 2 or 3 weeks such species as are able to respond quickly to those conditions are the ones which have a fair chance for success, because such conditions may not be duplicated again throughout the season and the species which germinate slowly may be only beginning to respond when the favorable period closes. Hence the inherent germination characteristics of tree seeds have an important bearing on the limitations of the species.

SEEDLING ESTABLISHMENT.

Establishment involves the ability of the seedling concerned to take advantage of the favorable periods of soil moisture, soil temperature and light. First of all, as shown above, the seed must germinate quickly when the favorable conditions obtain in order to gain its greatest possible development before the adverse conditions overtake it. A favorable period of 6 weeks may suffice to germinate and establish a seedling when the seed germinates in 10 days or 2 weeks, but one which requires 4 to 6 weeks to germinate will have developed just far enough to be the victim of the first unfavorable period of drought or temperature. The surface soil often dries out quickly on exposed sites and the seedling with only a short radicle is soon caught by such dry periods, while the seedling which produces a deep root early in its development can resist such short unfavorable periods. This is a fundamental principle which often determines the success or failure of a species. The size of the seed is the important factor because on the stored food in the endosperm depends the early rapid development of the plant. These points are graphically shown in plates 1-5. It is these facts which give the yellow pine the advantage over the hemlock and its associates on the severe sites in the forests of western Montana and Idaho. For the same reasons the Douglas fir is able to establish itself on the drier slopes of the Cascades, while the cedar and hemlock fail. A south slope covered with yellow pine or Douglas fir and a north slope covered with hemlock, white pine, cedar and other species does not necessarily mean that each of these species is in its optimum habitat, but that these are instances of competition and establishment. The yellow pine would produce even a better forest on some of the slopes occupied by the other species if it could establish itself there, but conditions unfavorable to its establishment prohibit its presence. Its development on such sites is shown by the magnificent single yellow pine trees found among the north and east slope types. On the other hand the hemlock and cedar do very well under the conditions of the south slope wherever they can get conditions favorable
to their establishment. The reason these species are not mixed all through the forest is not due to the lack of seeding or even to the germination of the seed on the different slopes. This point is emphasized where these types meet on a ridge. The south slope is seeded with the seed of the species found on the north slope and the seeds of the hemlock, cedar and Douglas fir, as well as the yellow pine, germinate in the spring but the seedlings with only shallow roots cannot resist the period of summer drought and in the fall only yellow pine seedlings remain. These conditions are repeated year after year and still the type remains the same. It is very noticeable that wherever conditions favorable to establishment have obtained on the south slopes the north slope species are found, sometimes in very unexpected localities.

When the seedlings or trees of a species are found on any site it shows that that particular site is favorable to the species found there, but it does not prove that any other species would not establish itself there or develop on the site if given a chance. Sometimes it is merely a question of which species happens to get possession of the area after the forest was removed, or which species first had the opportunity of migrating there, while in other instances it is clearly a matter of competition or ability to withstand the conditions of the site involved.

Species are, in general, rather impartial in regard to soil if we except chemical and physical extremes (abundance of common salt, lime, or of water) and if they have no competitors. In the middle of its distributional area a species makes no selection as to soil, but outside this central position it is forced by other species to exercise a choice. Nearly all species are facultative and their occurrence depends upon competitors. If these be present the one drives back the other and the victorious species is the one which can best utilize the given combination of soil, light, moisture, temperature, etc., during its period of germination and establishment.

Where forests of one species are sharply delimited from forests of other species it is not a question of inability to thrive at the boundaries but rather a question of what use the species can make of the favorable periods during establishment. In many instances a species will succeed and develop as well or better far beyond its natural range if assisted artificially during its seedling period. While these facts have been recognized in reforestation the failure of nature to accomplish the results has been attributed to factors other than seed viability and vitality. The importance of physical factors must not be minimized in considering limitations of type but the most important factor in local limitations, the seed and its characteristics, has not been considered in the past.
Plate 1. Three-fifths natural size, Western yellow pine (Pinus ponderosa).
A. Seed with wings.
B. Seedling before seed coat is dropped.
C. Seedling with cotyledons—note length of radicle.
D. Seedling one year old—note well-developed root system.
Plate 2. Two-thirds natural size. Western white pine (Pinus monticola).

A. Seed with wings.
B. Seedling before seed coat is dropped.
C. Seedling with cotyledons, long radicle.
D. Seedling one year old—well established.

The disadvantages of white pine compared to yellow pine are its slow germination and development.

A. Seeds with wings.
B. Seedling before seed coat is dropped.
C. Seedlings with cotyledons.
D. Seedling one year old—deep rooted.

The Douglas fir does not establish itself so early in its development as the white pine.
Plate 4. Five-sixths natural size. Western red cedar (Thuja plicata).

A. Seeds.
B. Seedling with cotyledon.
C. Seedling one year old.
D. Seedling three years old.

Note small seeds and seedlings. This species requires three favorable seasons in order to become established.
Plate 5. Seven-ninths natural size. Western hemlock (Tsuga heterophylla)

A. Seeds and wings.
B. Seedlings before seed coats are dropped.
C. Seedlings in cotyledon stage.
D. Seedlings one year old.

The size of the seeds and the small seedlings during the cotyledon stage and through the first season all show the favorable conditions the hemlock requires for establishment.
Utilization of Wood Waste

CARL A. KUPFER, B. S. F.
Forest Examiner, U. S. Forest Service.

Imagine if you can a slab fire which has been kept alive day and night almost continuously over a period of 55 years by the refuse from a single large sawmill. Try to realize that this is an actual mill operating in the redwood region of California and that it is only one of many mills of similar size. You can not then help wondering why so much potentially valuable material must be wasted.

In a country like this with its immense supplies of raw material and its relatively small population per unit area the answer is not easy. Distribution for fuel is prohibited by hauling costs. Smaller countries with fewer resources and more dense population, with highly specialized industries, with demands caused by a keener struggle for necessities and luxuries, have been driven to closer consideration of the question and have to a great extent solved it. For example, wood waste in the densely populated portions of Europe means sawdust, and not much of this relatively unimportant material is actually wasted. It finds use as fuel in natural form, in briquettes, and as gas resulting from distillation. In combination with binding and cementing substances such as glue, albumin, blood and resin it forms plastic materials, artificial wood and xylolith or woodstone. In cheap but often very durable linoleums it takes the place of cork, a more valuable tree product. Various processes of manufacture produce from sawdust oxalic acid, acetic acid, formaldehyde, tannin, dyes, grain alcohol, wood alcohol, oils, tar, charcoal, etc.

In the United States until quite recently wood waste has meant practically all of the wood produced by the forest which could not be converted into salable lumber and from such lumber into buildings, railroad cars, ties, vehicles, furniture, fixtures, barrels, boxes and so on down through the list to knobs for tea kettle lids and the dowels which are concealed in many larger wooden commodities. In terms of a tree the sum of these represents about one-third its volume. The other two-thirds constitute wood waste. Specifically, wood waste consists of stumps, tops, broken logs, inferior species and other material left in the woods, of sawdust, bark, slabs, edgings, trimmings, poorly sawn boards and lumber depreciated in seasoning, all incident to manufacture; of sawdust, shavings and blocks which do not find use when the lumber is remanufactured into things people need.

The refuse left in the woods is not only lost but becomes a menace to the remaining forest by harboring disease and insects and by serving as tinder which a stroke of lightning or
a careless camper, hunter or smoker may convert into a destructive fire. The refuse of a sawmill, except for the portion which can be used for fuel to drive the saws and other machinery, must be disposed of at the expense of the owner. A mill producing daily 100,000 feet board measure is not large as mills go, yet it is estimated that $10 is a fair average cost for destroying the waste from a day’s cut. The total annual waste of all mills in the United States has been given as 36,000,000 cords or 4 1/2 billion cubic feet, enough to make a solid cube one-fourth mile high. Naturally the intelligent, progressive lumberman desires very much to find a use for his waste raw material and considerable sums have been spent in experimentation looking toward means of accomplishing this.

Keen competition has reduced the profits on lumber until at times they have threatened to disappear entirely. Under these conditions the profits on by-products may play an important part in the advancement of wood-using industries now employing 10 per cent or over 1,000,000 of the country’s wage earners, and having an annual output roughly valued at $2,000,000,000. The cutting of timber has progressed at three times the normal rate of growth and of the original 5,200 billion feet in our virgin forests, 2,300 billion feet have been removed. The danger of timber famine has been pointed out and has given rise to the widespread study of conservation. This in turn has fostered utilization and we are on the way to doubling our forest resources by reducing waste. In 1914 the estimated wood waste used as pulpwood by our sawmills amounted to 330,000 cords valued at about $1,400,000. In the same year these mills consumed an estimated total of 4,290,000 cords valued at $36,800,000. The average cost per cord of wood delivered at mills of reporting concerns was $8.58; for wood waste only $4.25. The Forest Products Laboratory reports that one lumber company in the Lake States region claims the removal of 3 times the material from the forest and the employment of twice the number of men formerly employed in producing an equal amount of lumber. A progressive lumber company in Pennsylvania is securing from its waste a gross return of $124 per acre, or 34 per cent of the total gross return from its hemlock and hardwood logs.

Germany has accomplished more along the line of systematic development of forest resources than any other country. In the roll of honor the United States ranks second. No small part of this is due to the work done in the Forest Products Laboratory at Madison, Wisconsin, established in 1910 by the Forest Service of the Department of Agriculture in co-operation with the University of Wisconsin. Nowhere else in the world is there a laboratory of this kind so completely equipped. Its various sections specialize in investigations of the mechanical, physical and
chemical properties of woods, the value of various species for pulp and paper manufacture, the art of timber preservation to prolong its life, and the destructive agencies which cause decay and other kinds of depreciation. The drying of lumber by both natural and artificial means, testing of special preservatives and processes of preservation for individual species and for particular purposes, development of improved methods of pulp and paper manufacture and of wood distillation, and the practical application of results in the arts and industries are among its activities.

Sudden changes in commercial relations caused by the European war have given stimulus to numerous domestic industries. Some of these utilize forest products. Osage orange dye, produced from mill waste, has within the last year been developed as a substitute for fustic imported from Jamaica, Southern Mexico and Central America. Over $1,000,000 worth of this dye was produced in 1916 and osage orange has gained lasting commercial recognition as a dyewood.

Charcoal is used in the manufacture of black powders and in driving bullets from shrapnel. It is also indispensable in the production of certain high grade steels required for guns and armor plate. The nitrate fibres used in nitrocellulose powders must be treated with a solvent and acetone, made from acetic acid, a hardwood distillation product, is employed for this purpose. Without acetone, procured largely from this country, Great Britain could not produce the cordite used by her soldiers on the battlefield. In this connection it may be interesting to note that a study by the Laboratory experts of the operating methods in a destructive distillation plant resulted in one case in increased yields of products valued at $15,000 annually. Another investigation resulted in the use of spent tanbark in the manufacture of patent roofing to the extent of 160 tons per week. The value of the bark has thereby increased from 60 cents to $2.50 per ton. The tanning industry now handles over 1,000,000 cords of waste per year. Some of this will be used in making sheathing paper, carpet liners, bottle wrappers, deadening felts and similar articles for daily use.

Formaldehyde, the universal disinfectant, is manufactured on a commercial scale entirely from wood alcohol. It would be difficult to estimate how many human lives are saved by preventing the spread of contagious diseases with this effective enemy of the germ. The agriculturist finds a use for it in disinfecting seeds, thus assuring a greater food crop.

For 5 years the Laboratory has been working on the production of grain alcohol from wood. In this time the yield has been raised and the cost of production lowered. Waste material of coniferous species has been found to give higher yields than do hardwoods. Chemical analysis of certain woods, notably western larch, has shown them to be especially rich in a water
solution material, galactan, which, converted into fermentable sugars, constitutes raw material for grain alcohol. Larch sawdust, hydrolyzed under pressure with acids, yields sufficient sugar to produce 35 gallons to the ton. Spruce sawdust yields 25 gallons. Probably 40,000,000 gallons of denatured alcohol were used in the United States in 1916, and huge quantities were exported. Grain alcohol from wood is no longer a mere possibility; it is today being manufactured in a large plant located in the South and using mill waste of southern yellow pine. Thus Mark Twain’s statement that the country would never go dry as long as every table leg was good for a jag seems to be verified. Nor is this all. Galactan in oxidation yields large quantities of muric acid, a substitute for tartaric acid in the manufacture of baking powder, an industry in which large quantities of tartaric acid are employed. Hydrolyzed galactan becomes galactose, which, with the addition of a small amount of alkali and subjecting to heat, is transformed into a fine sweet syrup.

Seven billion pounds of artificial silk made from wood are used annually in this country. This material goes into silk sweaters, hose, neckties, fancy braids and millinery. It is merely cellulose reduced chemically to a gelatinous substance known as viscose. Some of the tough sausage casings now in use are also made of viscose, and this substance will undoubtedly find a great many uses. In Germany, since cotton is no longer obtainable in sufficient quantities, soft, artificial cotton is made from wood cellulose for surgical purposes.

Another interesting field of research for the utilization of wood waste and one giving promise of unusually important commercial results has to do with the manufacture of kraft paper and its remanufacture into a great variety of products. Kraft is a very tough paper because the action of the chemical used for reducing the wood to pulp is not severe enough to seriously weaken the fibres. Its natural color is brown, but it can be dyed easily by adding color to the pulp. In the form of tough, heavy wrapping paper it enters every home. Longleaf pine, western yellow pine, sugar pine, redwood, white fir, red fir, and a number of other species yield excellent kraft. It is used for large envelopes, book covers, imitation leather, especially that employed in the furniture industry, cardboard and matting suit cases, etc., and if cost of leather continues to go up we may eventually wear wooden shoes made from specially prepared kraft. Like most papers it is usually made up in the form of wide sheets which are wound on cores into large rolls. These rolls are cut into long ribbons or strips of varying widths which are in turn fed into spinning machines for the production of yarns and reeds. Sometimes the paper is gummed and coated with cotton fleece before spinning and the yarn so produced is used in the manufacture of cheap towels and napkins. One
of the largest single uses of spun paper in the United States lies in the production of so-called fibre rugs. These may be made entirely of paper or of paper and cotton or wool. The total daily output of such rugs is probably in excess of 100 tons.

Paper furniture is now a common article of commerce and its use should increase greatly. The reeds are usually made from heavy paper, stiffened by various processes, and when woven over wooden frames and coated with shellac, they produce an excellent substitute for other reeds.

Rope and cord made from kraft alone or from kraft with a core of hemp or sisal are finding considerable favor. Cheaperness, smoothness, uniform strength and size are the points in which they excel other cords. European manufacturers are producing clothesline, sash cord, driving reins, skipping ropes, web straps for surcingles, and a variety of articles from paper twine. Floor mattings, stair runners, imitation burlaps for wall coverings, tapestries, and bagging to replace jute are other products. Eventually paper yarn will be woven into cloth to be used in making cheap clothing for rough work. Binder twine from paper to replace that made from imported fibres is another possibility of economic importance in our industrial development. Insulating tubing for electric wires, both for use under ground and overhead, is made partly from paper, as is also pipe for carrying liquids.

As a means of reducing wood waste by bringing wood users together the Office of Industrial Investigations of the Forest Service has opened a wood waste exchange. The co-operators now number over 500, many of whom have reported successful purchases or sales of wood waste through the Exchange. Thus a man desiring blocks for brushes may find that he can obtain cheaply for this purpose material which in another industry is waste.

Forest products investigations covering comparatively few years have opened our eyes to the uses of today and the immense possibilities of the future. The consumption of forest products is increasing, and the degree to which wood waste contributes to these products is the degree by which we are approaching the very remote goal—complete utilization. As the value of the tree is increased closer application of correct forest management is made possible. With this comes the assurance of steady supply and the consequent development of wood-using industries.
The Stumpage Situation in the Pacific Northwest

G. C. MORBECK, M. F.
Associate Professor of Forestry, Iowa State College.

Standing timber is a natural resource which permits of fairly close measurement. The virgin supply in the country is strictly limited. Unlike other natural resources, such as minerals, gas and petroleum, the timber has all been located, and the total volume more or less accurately determined.

It is thought that the forests of the United States at the time of the country's discovery contained upwards of 5,200 billion board feet of timber. The latest reliable reports place the present stand at somewhat more than one-half the original estimate, or about 2,700 billion board feet. The commercially important stands in the eastern states have been largely cut over. Michigan, which for 3 decades held first place in lumber production, is now surpassed by a dozen states, none of which produced lumber in any quantity 25 years ago. The cut of white pine in this state is so small in recent years that no mention is made of the species in the government reports. When one recalls that only a few years ago Michigan was the leading state in the manufacture of pine lumber, the rapid disappearance of the forests is brought vividly to our minds.

There are still large tracts of timber in the southern states, but these are also being rapidly reduced through extensive exploitation.

The western states are now the great reservoirs of virgin timber in the country. About three-fifths of our entire supply is found in the states bordering the Pacific and in Idaho and Montana. The bulk of the stumpage is owned privately, and mostly in the form of large holdings. Small tracts are being acquired by the larger concerns, at prices usually fixed by the latter. Individual claims or groups of claims not yet bought by these large holders are either inaccessible, or are being held at too high a figure. In a few cases where the timber may be easily logged, the small holder exploits the area himself. Besides the privately owned timber there is a vast amount of stumpage in the Government forests, and on Indian reservations under Government control. It is from these great western forests that the bulk of the country's supply of wood will be obtained for many years to come. At the present rate of cutting they are practically inexhaustible, but the cut will increase many times in the next 25 years, as eastern and southern forests become depleted. However, with a decreas-
ing per capita consumption of lumber and an increasing percentage of utilization, the western forests could be quite easily perpetually maintained under good forestry management.

Investors in western timberland are largely from the Lake States and eastward. They witnessed the tremendous fortunes derived from the lumber business in the east and sought to duplicate these achievements in the undeveloped west. Great tracts of stumpage were purchased in the early days at low prices. As timber became scarcer prices rose and finally, in 1906, under keen competition, stumpage in certain regions reached a figure almost equalling its real value.

The true worth of standing timber is determined by the average mill run selling price of the product manufactured from it. The price is fixed by the most valuable product made from the species in question. It may be lumber, or staves or shingle bolts or any one of a hundred other commodities made of wood. From the average mill run selling prices are deducted the operating costs—logging, milling, and overhead charges—involving the standing tree into the finished product on board the car ready for shipment. A certain percentage is allowed on the costs of the operation and on the stumpage as profit. The remainder represents as nearly as can be determined the true stumpage value of the timber.

Outside the Forest Service, however, a totally different practice is followed in determining stumpage values. The basis of this system is the first cost of the standing timber. To this is added each year the carrying charges, consisting of taxes, protection costs, and administration expenses. A reasonable net annual return on the money invested is also expected. The nature of the investment makes it imperative that interest rates be higher than those obtaining for loans on property where the risk of destruction is not so great. The net annual return charged against stumpage is about 7 per cent. At this rate compounded semi-annually, stumpage doubles in price every 8 years.

Pacific coast forests are hardly maintaining themselves. The timber is mostly over-mature, and the loss from decay is not replaced by the added growth of the live trees. In certain regions, as the Wind River country in Washington, and on the Umpqua Forest in central Oregon, the trees are very largely dead or defective, and the annual loss by death and decay exceeds the growth many times over. The white pine forests of northern Idaho are just about holding their own. The growth in the younger merchantable stands which is normally quite large is kept down by the ravages of the white pine bark beetle (Dendroctenus monticolus), until probably the destruction exceeds the growth. The older stands are deteriorating more rapidly from this and other causes. On the whole, owners of stumpage in the Pacific Northwest cannot expect any increase in value
of their lands due to increased growth. It may be said, however, that most investors in timber land do not figure on an increase in value due to increase in volume of mature or semi-mature stands, but are perfectly satisfied if the present growth does not materially decrease in quality or in amount until such time as it is cut.

The principal factor upon which investors in Western stumpage based their hopes of large profits, was the steadily increasing price of lumber and a corresponding rise of standing timber. The early purchaser of stumpage had ever reason to believe that lumber would continue to soar in price, since each year saw a diminishing reserve and an increased output. A study of past lumber prices shows a steady rise over a long period. There were short periods during depressions when lumber quotations remained stationary or even declined slightly, but normal conditions were quickly resumed with their passing. Favorably located stumpage, however, had never declined in price. Relatively speaking, it had never caught up with the lumber manufactured from it. It had constantly mounted to higher levels, and in so doing had made millions for fortunate investors.

Conditions in the lumber business have undergone a radical change in the past decade. Lumber prices have not risen as anticipated. In fact, for most species they have actually decreased since 1907. The decade prior to this date were boom times in the timber business in the West. Money was plentiful and timber was cheap and operators and investors bought up all the available stumpage in their buying spheres at low prices. As timber became scarcer, choice tracts increased in value, and by 1907 prices very nearly approaching the true value of the stumpage were paid in many regions in the West. With the panic of 1907, buying stopped as suddenly as it began. Sellers were holding for high prices which the buyers have been unwilling to pay.

The average mill run selling price of all lumber manufactured in the United States in 1906 was $16.54. In 1915 it was $14.04, which indicates a loss of $2.50 per thousand feet in ten years. Douglas fir dropped $3.61 per thousand feet; white pine, $ .88; spruce, $.75; western cedar, $2.02; redwood, $3.10. The only increases were in western pine which advanced $.31 and sugar pine which rose $1.29. The decreased selling prices indicate a decreased value of stumpage. Timber purchased in the days when stumpage was cheap and estimates low could stand the slump fairly well, but that bought at or near the end of the period when stumpage often brought its true value are really in a serious plight. Carrying charges and interest have mounted steadily upward each year, and for 10 years past the price of lumber has steadily declined, while stumpage has remained stationary.

Such a condition as outlined above, if maintained, must soon
A typical stand of coast timber on the Columbia National Forest, near Carson, Wash.
result in wholesale destruction of the forests to prevent loss on the part of the owners. A very good illustration is shown in the case of a certain tract of white pine in northern Idaho. Approximately 8,000 acres were purchased in the region in 1906 under severe competitive conditions, at prices very near the true value of the stumpage. During the next decade white pine lumber actually decreased in value $ .88 per 1,000 board feet. The carrying charges and return on the money invested demand that the timber be worth 125% more than the original purchase price. Four thousand acres of timber adjoining the 8,000 acres purchased in 1906 were acquired under competitive conditions in 1916. The prices paid were less per claim and less per 1,000 feet than for the contiguous tracts of timber purchased 10 years before. From these figures it is clearly seen that the calculated advance in stumpage did not materialize; in fact, during the period, based upon the selling prices of the finished product, the value of the standing timber actually decreased. During 1916, however, the selling prices of white pine lumber have advanced and the condition of stumpage has greatly improved. The 4,000 acres mentioned above were recently resold, for immediate cutting, at a very substantial profit.

White pine is a highly specialized wood. It is used for certain purposes for which there are no suitable substitutes. The ease with which the wood can be worked, together with its light color, even grain and freedom from shrinkage, warping and checking after seasoning, makes it highly desirable in the mill-working industries. Millwork plants consume over 50% of the total output. The demand for white pine is always strong. The supply of standing timber is strictly limited. There should be a steady rise in the price of lumber and of stumpage, as the exploitation of the forests depletes the supply.

Coast species, Douglas fir, western hemlock, western red cedar, white fir, redwood, spruce and others of less importance occur in heavy stands covering large areas. These woods, especially the firs and the hemlock, have no highly specialized uses, and actively compete with each other in the general trade. Statistics stated elsewhere show that Douglas fir, the species having the greatest volume of standing timber, the largest output, and the most diversified uses of all coast trees, decreased in value $3.61 per 1,000 feet b. m. in the ten-year period following 1906. The value of stumpage has declined in exact ratio to the drop in the price of the manufactured product.

The selling prices of coast stumpage have not actually been lowered in recent years, neither have they advanced perceptibly. Substantial profits have been made on recent sales of standing fir timber, but the rise in prices was not due to increased values per thousand feet, but rather because more careful estimating has revealed heavier stands than earlier cruises indicated. Many of
the recent sales were made to operators who contemplate immediate exploitation, and hence were in a position to pay relatively higher prices than those buying as an investment.

Owners of coast timber have not realized their expectations in the matter of stumpage values. Early purchasers at low prices are realizing a fair rate of interest on their investments, but probably not greater than that obtained for money invested in other property involving much less risk of destruction. The profit, if any, will come through closer estimates of the timber showing heavier stands. Later purchasers paid higher stumpage prices on much closer estimates than were originally made. They cannot hope for a great increase in volume in the years to come, but must base their expectations of profits almost entirely upon the rise in stumpage values. As stated above, standing timber has not risen in value in ten years; in fact, it has actually declined. The prospects of increased stumpage values in the near future are not especially bright. Large exports to European countries and the extensive building of wooden ships, as now contemplated, may change the situation and bring about better stumpage conditions.

Except for species having highly specialized uses, the values of western stumpage will remain stationary or at least will rise only slowly for some time to come. The increased demand for wood after the great war will no doubt stiffen prices somewhat, but probably not permanently. There are many factors which tend to verify the above statement. Probably the most important one is the fact that many operators and investors own more stumpage than they can cut in a reasonable length of time. In order to protect their investments they must increase their outputs by building additional mills, or sell a portion of the stumpage to other operators. In either case more lumber is produced, and overproduction results. Overproduction means increased competition, which in turn means lower prices for the manufactured product. Since the value of standing timber depends directly upon the selling prices of lumber, stumpage also declines.

Another factor which will have a decided influence on western stumpage values for many years, is the fact that there still remains in the east great producing forests much nearer the large centers of consumption than is the coast timber. The Great Lake States forests are rapidly becoming exhausted and the southern mills have reached the peak in their production, hence competition with lumber from these regions will be less keen in the future and prices of western products will gradually rise.

It is doubtful, however, if the increase in prices due to the cutting out of the eastern forests will keep pace with the increased cost of production. Taxes on timber land have increased tremendously in every western state during the past decade. Protection costs are considerable and are mounting higher each year. Logging and milling costs have advanced materially in every
A well-ordered national forest timber sale area, after a cutting. Plumas National Forest.

An excellent stand of pure white pine in northern Idaho. The timber averages eighty thousand feet B. M. per acre.
region, due to increased wages, cost of equipment, materials and provisions.

The per capita consumption of wood is decreasing annually, and the output of the mills remains stationary. The number of wood substitutes is increasing yearly and the amount of wood displaced by them already equals about one-fourth of our total lumber cut. Wood preservation has made inroads into the lumber industry by doubling or trebling the life of timber. Much greater utilization in the forest, at the mill, and at the point of consumption, is practiced today than ever before. These and other factors tend to regulate the price of lumber and of stumpage; and though the country has actually less timber than it will consume during the next 50 years, under the present conditions of the lumber industry; it must be cut and disposed of as rapidly as possible to avoid loss to the present owners. Under conditions which exist today every owner of coast timber will be compelled to cut his stumpage within a comparatively short time, unless some relief is forthcoming. To cut the timber regardless of market conditions would be a national calamity. It is to be hoped that some way may be found to handle this extraordinary situation, so as to protect the owner, safeguard the public, and in this way save a great National resource from wanton exploitation and permanent destruction.
Planting Trees on Kansas Prairies

I. T. BODE, B. S. F.
Nurseryman, Fort Hays Branch Experiment Station.

Kansas always has been and always will be essentially a prairie state. But every year brings more convincing proof that her plains need not always remain treeless. Each planting season sees new effort put forth to beautify the Western Kansas homes and divest the plains of their traditional bleakness.

The state possesses a wide range of climatological conditions and physiographic features. In passing from east to west one notes a gradation from the wooded stream banks and timber belts of the eastern sections to the wide flat plains of the extreme west and southwest, where a tree becomes a novelty. The climatic conditions change from those of the average Mississippi Valley state to those of the plains regions. The rainfall drops from an average of 35 to 37 inches to an average of about 16 inches. The winds rise gradually until in the western section velocities of 20 miles per hour are very common and those of 35 to 40 miles are frequent. The lack of protective belts and the dry prairie soils increase their drying effects and enable them to carry the soils more and more, until in the western parts of the state soil blowing becomes a serious problem. The precipitation is likely to come more or less spasmodically, being heavy during the winter and spring of the year and little or none during the summer months. Hail is frequent and often does a great damage by defoliating and even barking old as well as young trees. Winterkilling becomes important, not because of the low temperatures, but because of the late fall and early spring warm spells. These sometimes occur as late as December and as early as February. Often sap will begin to rise. Nearly always such warm spells are followed by cold waves and freezing weather. Winterkilling is the usual result. Such conditions increase the vicissitudes and limit the scope of the tree planter's work. They make hardy species and intensive methods of moisture conservation imperative.

However, to those who really know the state it is not as wild and barren as popular opinion would have it, and there are evidences of earlier days which hold forth promise of a certain amount of success in tree planting for the future. It is probable that the Kansas plains were not always as destitute of trees as they are at present. For example, on the Fort Hays Experiment Station, which in the early days was the Fort Hays Military Reservation, a belt of heavy timber borders Big Creek as far as the reservation extended. Beyond these limits the timber breaks off suddenly.
The type of Kansas home which the present generation is rapidly beautifying by tree and shrub planting.

A view in the timber belt bordering Big Creek, on the Fort Hays Experiment Station, Hays, Kan., formerly the Fort Hays Military Reservation. The above shows Custer's Island, where George A. Custer and party were surrounded by Indians, later marooned by high water and finally forced to swim their horses out to escape.
A Catalpa speciosa plantation on bottom land in western Kansas. Plantation is 3½ years old, rows 3 feet apart. Catalpa is hardy on bottom land but grows scraggly on upland.

A typical sod house of the pioneer day. Such remnants are scattered throughout the western sections of the state and give evidence of the early scarcity of timber.
and is then noticeable only in irregular blocks along the stream. Evidence of single specimens or small groups of very old mature timber along other creek bottoms and along draws throughout the Western section seem to point further to a day when these lower areas and stream banks all may have been more extensively wooded. Many instances are found, too, where tree growth breaks off in a sharp line just beyond some stream or other natural barrier. It is not at all improbable that these are the results of destruction by fire. The Indian of the early days fired the prairies to destroy pasture and game against the approach of his unfriendly neighbors, and in so doing he was not scrupulous about encroaching upon any timber land which might have existed. The great prairie fires which have become more or less history, regardless of their origin, undoubtedly decreased any existing timber areas. Then, too, the early settler demanded fuel and structural timber. Just how far-reaching such destruction was is difficult to say in view of the remaining remnants of the old sod house and of the reports of the great distances to which lumber was carried overland. However, it is reasonably safe to suppose that inroads were made on any native timber then standing.

Nevertheless, trees were then, as now, “conspicuous by their absence” in Western Kansas, and the second generation of settlers especially, who were not compelled to spend every spare minute to win a bare existence from the soil began to demand trees of some kind. The earliest efforts at tree culture were made in the form of the old “tree claim.” Spotted all through the western sections of Kansas may be found remnants of these plantings in varying stages of preservation. They do not exhibit magnificent trees, but they give promise of better results with more intensive methods. In nearly every case the plantings have become scraggly and deteriorated, mostly because of neglect and very often because of poor varieties. Land was the object of the plantings, not trees. As a result they were set and left to their own salvation in the battle against the hardships of the soil and the prairie sod.

The present generation, however, are no longer land seekers; they have become land-owners and home-builders. Now comes a new demand for trees to make Kansas homes more livable. Through this second demand or awakening has come more systematic effort, and gradually the people are beginning to realize that tree planting is not an impossibility, that it is a necessity, that it will pay in some form or other sooner or later. It was to further these efforts that a State Forestry Department was established with a State Forester at its head. Two state nurseries are now maintained, one in the Eastern and one in the Western section of the state. The stock is distributed to the people of Kansas at the cost of production. Kansas has again been brought
to face the tree planting problem; but they are being attacked in a new light.

It is perhaps safe to say that the maintaining of a nursery in Western Kansas is one of the greatest stimuli to tree planting. A commercial nursery in this section at the present stage would undoubtedly "go broke." The state is about the only institution which can afford to handle such a proposition for the sole purpose of "furthering the cause." The results that are being obtained justify the maintenance of the institution. Through the Western Nursery, located at the Fort Hays Experiment Station, Hays, Kansas, the source of supply is placed much nearer to the purchaser and furnishes planting stock at a season which is comparable to the planting season in this section of the state. While it may seem a small item to say that many people are induced to plant trees through visiting the Forest Nursery and through simply feeling that the stock is near at hand, in reality this influence is surprisingly large. The majority of the trees shipped from the Hays Nursery go to the Western part of the state, and the "yard business" is nearly as large as the mail order business. A large number of the Western Kansas farmers have only moderate incomes, and they look at the increased freight and express charges for long distances a long time.

Then, it is important that the stock be ready to plant when the time comes to plant it. The planting season is apt to be short, early or late. Where the stock is raised under the conditions of the region it keeps pace with the season so that it lies dormant or begins to grow according to local conditions. This is apt to cause less delay if the season is early or furnish stock which is not too far advanced if the season is late. This factor is not important where the seasons change steadily, but where there are such fluctuations as in Western Kansas it has an important influence. Also, if hardy varieties are to be found and raised they must be tested under conditions prevailing.

In spite of all the need for trees, the Forester still has problems to overcome in furthering the tree planting movement. He has to bring the people to adapt their ideas of tree growth to existing conditions. A large part of the population has come from sections of the world where trees have grown in abundance and with little or no care. Kansas was treeless when they arrived; it surely was supposed to remain so, in their judgment. Popular belief has said, "Trees cannot be raised in Kansas," and this has settled all debates for many. The early efforts in the form of the old "tree claim" were a failure. To others this is conclusive proof. Regardless of the results of plantings in older towns and the specimens that exist where care has been given, it is hard to convince the "old timer" that he can afford to plant a tree. Such convictions have their foundation, it is true. A season such as 1915 with a total of 34.14 inches rainfall
Shelter belt planted in 1905 and 1906.

Same shelter belt from opposite side seven years later.
A view of the park maintained by the Fort Hays Experiment Station at Hays, Kan. The above was taken in 1912, seven years after planting. Cultivation maintained throughout.

A hackberry plantation in western Kansas, three years old. Rows are four feet apart. A hardy variety for this section.
well distributed throughout the year adds enthusiasm to the tree planting movement; but one like the past season of 1916, with only 16.01 inches rainfall and only 5.3 inches of this amount after June first, is exactly the opposite and requires a great amount of optimism and persistence. Trees 12 and 15 years old which have been thrifty, well established and well cared for have died in the one season. Then further, the idea that the trees raised are not worth raising puts out of the running many who have become accustomed to the tall stately tree of the timber regions from which they came. It is hard to convince them that the low topped, bushy growth is best adapted and is really a tree; that it must serve at least as the forerunner of the more stately type. Such are the prejudices which must be overcome.

Winds are perhaps as limiting a factor to tree growth as any other. There is no question as to their effect upon tree forms and plant life. A tree grown in the open is almost certain to become one sided, and even when grown where partially protected shows the one sided effect distinctly. Besides, the winds during the growing season, of a dry year especially, are hot and drying and evaporation is extreme. For these reasons the low headed bushy tree is the best type adapted to the region. The success of the tree planting movement, therefore, depends largely upon the development of wind and drought resistant varieties.

The greatest education needed is, as in any forestry movement, that of the care of the tree. If it is important to cultivate, water and care for tree plantings in more favorable climates, it is doubly important in the prairie state. Vegetation which does exists, exists because of its very ruggedness and ability to withstand hard usage. It will take a tree of the same type to battle against it, and there are few species which will do so without help. With help much can be accomplished. Species which have been found to withstand conditions best are: White elm, Norway Poplar, Honey Locust, Kentucky Coffee tree, Tamarix (shrub and hedgeplant), Osage orange, Russian Mulberry, Russian Olive, Redbud, Cottonwood, Hackberry, Chinese Arborvitae, Red Cedar (Juniperus Virginiana) Austrian pine and Yellow pine.

The best trees are those which have been longest cared for. A public park maintained by the Fort Hays Experiment Station, which has been planted between 10 and 12 years, has been kept under thorough cultivation. The trees have made a remarkable growth and now stand as excellent examples of what can be accomplished with care. Another plantation of Catalpa (Catalpa speciosa), now 11 years old, has produced between 250 and 300 fence posts on 1½ acres, the posts averaging about 4 inches top diameter. While such may be only scattering exam-
pies, they show what can be accomplished with a certain amount of effort.

The tree planting movement will gain in proportions as the people learn the possibilities and realize the effort needed. The percentage of loss is greater than in more favorable climates, hence, the effort must be proportionately increased. But the value of the surviving per cent is so much greater in comparison that it should be looked upon as well worth the added effort. As the people realize this more and more they are increasing their interest and persistence.

The State Nursery at Hays is maintained in connection with the Fort Hays Experiment Station. From a Nursery of approximately one acre 5 years ago and containing but a few trees it has grown to one of 25 acres and contains some 250,000 trees and plants of various ages and sizes. The demand for trees that the Nursery produces has grown in the same time from a few trees planted at the Station for demonstration purposes to one of approximately 75,000 trees, which represents the approximate number shipped to all parts of the State each year. Of the trees sent out the number reported living after the first season’s growth has increased from 76% to 91%. Out of some 480 orders during the spring of 1916 only 12 went to points outside of the State.

Charts for each of the past five years showing points to which trees have been shipped from the Hays Nursery, show also that the Western sections of the State are receiving a larger proportion of the orders from the Nursery each year. With one exception, when there was a general decrease in the number of orders all over the state, the west has increased steadily while the east has fallen off. During the past year there was an increase in the two western sections of 37% and 146% respectively.

Thus, the desolate plains of Kansas are rapidly becoming farm homes, and the homes are being beautified. It will undoubtedly be a gradual process which gives the state any extensive timber belts, but the persistent efforts at shelter belt, shade tree, and shrubbery planting are bound to increase, and it is not unreasonable to dream of a day when the plains will be spotted with trees, marking the prosperous homesteads of the wheat farmers of the Sunflower State.
Part of the Forest Nursery maintained by the state of Kansas at Hays. The stock is distributed at the cost of production to the people of Kansas.
Scaling and Check Scaling in the U. S. Indian Service

RALPH W. HAYES, B. S. F
Forest Assistant, U. S. Indian Service.

Practically all timber cut from Indian land is sold by actual scale, so the scaling is one of the most important parts of every timber sale. Large sales are often made, requiring several years to cut and necessitating several camps in operation all the time. Each camp requires a scaler, so several scalers are usually employed all the time. The men who fill these positions are chosen from the best scalers in the community and have usually had several years' experience. This would seem sufficient precaution to take to obtain a good fair scale to all parties concerned, but it has been found true in all lines of work where a man does the same thing day after day that he becomes more or less mechanical in its performance, and this is true in scaling logs the same as in other work. To obviate this tendency and to keep the scalers alert at all times, the U. S. Indian Service has inaugurated a system of scaling and check scaling which brings out the best efforts of the men at all times and incidentally gives as nearly a correct scale of the logs as it is possible to obtain.

Timber sold from Indian lands falls into one of two classes—Allotted timber or Tribal timber. If the timber is cut from allotted lands the allottee receives all the money from the sale of timber on his own allotment, so it is necessary to keep a separate scale for each Indian. If tribal timber is being cut, each land sub-division is kept separate when scaled, even though the money goes into a fund for the tribe, and is either used for some help to the tribe as a whole or divided pro rata among them. Each sub-division is kept separate to make the handling of the funds easier, for all the money is usually held in trust by the government for the individual Indian, or the Tribe, and can be spent only under supervision. This will show the reason for the scaling units referred to later.

Paragraph 9 of the timber contract used in Indian Service timber sales reads as follows:

"Timber will be scaled, measured, or counted by officers selected by the officer in charge. The cost of scaling and of supervision by the United States officers shall be paid from the proceeds of the sale of the timber. Timber will be scaled by the Scribner rule, Decimal C, and if required by officer in charge, shall be piled or skidded for convenient scaling. The maximum scaling length of all logs will be . . feet. Logs over . .
feet in length will be scaled as two or more logs in length not less than . . feet when practicable, and with the proper allowance for the increase in diameter at the points of division. Upon all logs 3 inches additional will be allowed for trimming. Logs overrunning this allowance will be scaled as though 2 feet longer. Diameters will be measured inside the bark at the small end of the log and recorded at the nearest inch above or below the actual diameter. Proper deductions will be made for defects in logs.”

The blanks in the above form are filled out differently in different localities, depending on the nature of the timber. At the La Pointe Agency the maximum scaling length under the latest
Lot number end, showing this load containing logs from two descriptions, No. 29 and No. 25.

Scale number end of another load. Series 2235 to 2262—white pine. Series 1820 to 1831—hemlock. Series 962 to 966—balsam.
contract is 18 feet. Logs over 18 feet in length are scaled as 
2 or more logs in length not less than 12 feet when practicable.

The timber cut from Indian lands is always scaled before it 
is removed from the cutting area, usually on the land from which 
it is cut. In some cases, however, it is not practicable to scale 
on land, because of loading conditions in sleigh or dray haul 
camps, in which case the logs are scaled on the landing before 
they are put into the river or stream down which they are taken 
to the mill.

When a camp foreman receives his cutting list for the season 
he confers with the scaler assigned to his camp, and they designate 
each allotment, or sub-divison of 40 acres, by a number as shown 
in the accompanying diagram (Fig. I.). The reason the descrip­
tions to be logged here are scattered is because the area has been 
logged previously and all other timber removed from the locality.

As the area is cut over and the logs are skidded the number 
of the description from which each log is taken is placed on 
one end of the log, usually on the left hand end when facing 
the front end of the skidway. These numbers are put on the logs 
with black lumber crayon by the men who “tail down” at each 
skidway. The teamsters and foreman keep the logs separated 
as much as possible so only one description is logged at a time, 
but when logs are skidded to one skidway from more than one 
description the skidway man is always told what description the 
log comes from so he can number it correctly.

The logs from each description are recorded separately in 
regular scale books, the lot number always showing the descrip­
tion from which the log was cut. Sometimes a scaler is compelled 
to carry 8 or 10 scale books with him every day, especially 
in railroad logging, when one branch crosses several descriptions 
and loads are taken from each.

When the logs are scaled, each log must be numbered again 
with the scaling number, on the opposite end from the lot num­
ber, and the number on the end of the log must correspond to 
the number in the scale book opposite which the scale is recorded. 
This brings the scale number on the right hand end of the log 
when facing the front end of the skidway. Of course, this 
exact method may not be followed but it is easier for the scaler 
to put the scale number on the right hand end, and it is usually 
done that way.

Several species of timber are usually found on each descrip­
tion and in order to make the work of recording and report­
ing the scale easier, each species is given a series of numbers, 
or the leading species is given one series, and all others are 
grouped under another series. In the latter case the mixed 
logs are grouped under one series but each species is recorded 
on a separate page, or in a separate column of one page. For
example, if white pine predominates on one description, the white pine logs will be numbered beginning with 1, consecutively, until all are numbered or until the number 10,000 is reached, when the series again begins with 1, but with a line beneath as 1, 50, 697, etc., thus doing away with writing large numbers. All other logs from this description are classed under another series, exactly as above in numbering. The species, however, may be arranged as follows: Norway Pine, 1 to 100; Hemlock, 101 to 200; Spruce, 201 to 220; Balsam, 221 to 240; Birch, 241 to 260; Maple, 261 to 280; Oak, 281 to 300, etc., depending on the amount of each species on the description. The scale books used contain 75 sheets or 7,500 logs in each book. When one book is filled on one description another one is started, taking the numbers beginning with the next number above the last one in the old book, continuing until all the logs are scaled.

The actual scaling of the logs is done with the Scribner Decimal C rule. Deductions are made for defects and this, of course, is the place where judgment is necessary. Various defects, such as sap rot, stump rot, punk, shake, fire scars and damage, ant holes, dry rot, etc., all require different methods of figuring deductions, and the scaler must be sure of the scale of every log before he records it, for the inspector may decide to find out how much he gave for it. Lengths should be measured often for the sawyers sometimes make mistakes of a few inches in length, which often increases the scaling length of the log.

The scaler must be very careful to always record the scale of a log opposite its number for his book is his only record. It would be easy to get the scale mixed if the scalers were not always open to inspection and required to keep their books correct.

When the logs are being hauled by rail, and often in sleigh haul camps, they are moved or loaded so fast that it is impossible for one man to number and scale them, and keep ahead of the crew. In such cases a marker is provided for each scaler who numbers the logs as they are scaled. This gives the scaler time to inspect each log and be sure of his scale. A good scaler, with a marker, can scale from 125,000 to 200,000 feet of timber per day if necessary, varying, of course, with the size of logs and the average amount of defects.

Each scaler reports at the end of each week all timber scaled by him during the week, a separate report being required for each description from which logs were taken. Four copies of each report are required, one to go to the purchasing company, one copy to the Indian Agent’s office for the use of the clerks in figuring the value of the timber, one copy to the Indian allottee, if land is allotted, or to the inspector if the land is tribal, and one copy for his own reference, in making the next report from
that description, or for reference in case any trouble ever comes up regarding the report.

These reports are made on regular forms. The first column represents the number of logs of each species scaled on the particular description during the week; the second column, the scale for that number of logs. The two columns headed “Previous scale” show the number of logs and the scale for all timber previously taken, and the last or “Total scale” gives the total of the first two, or the total number of logs and total scale up to the date of the report. It is easy to figure from these reports the value of the timber removed at any given date, and if the original estimate is known, approximately the amount of timber is left on the area.

SCALER’S REPORT

For Week ending May 13th

Allotment on the

of Section, Town serialized...e. West, on the Red River Reservation, Wisconsin,

for J. S. STEARNS LUMBER CO., by......

<table>
<thead>
<tr>
<th>Kind of Timber</th>
<th>Scaled During Week</th>
<th>Previous Scale</th>
<th>Total Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mer, Green White Pine</td>
<td>1500</td>
<td>2200</td>
<td>3700</td>
</tr>
<tr>
<td>Green Norway</td>
<td>150</td>
<td>1000</td>
<td>1150</td>
</tr>
<tr>
<td>Green Hemlock</td>
<td>50</td>
<td>46</td>
<td>96</td>
</tr>
<tr>
<td>Basswood</td>
<td>250</td>
<td>60</td>
<td>310</td>
</tr>
<tr>
<td>Elm</td>
<td>41</td>
<td>17</td>
<td>58</td>
</tr>
<tr>
<td>Ash</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Maple</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Beech</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Oak</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Spruce</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Tamarack</td>
<td>40</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Balsam</td>
<td>44</td>
<td>160</td>
<td>204</td>
</tr>
<tr>
<td>Poplar</td>
<td>9</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>Totals</td>
<td>210</td>
<td>1460</td>
<td>1670</td>
</tr>
</tbody>
</table>

Each scaler’s work is checked up every week or ten days and the results reported to the Chief of the Indian Forest Service at Washington, D. C. Regular inspection forms are used, and are kept by the inspector, and are open to inspection at any time by the Chief or anyone from the Washington Office.

In checking up a scaler’s work the inspector selects the logs he will scale and puts the number of each log in the column headed “Log No.” and opposite this number in the column headed “Insp.” his scale of that log. Usually 100 or more logs are
taken for a check and these may be taken wherever the inspector chooses, or of any species or several species. When the desired number of logs have been recorded and scaled as described above, the inspector takes the scaler’s books and looks up the logs and records the scale found in the book for each log in the column marked “Scaler.” Each column is then added up and the total scale given by the scaler and inspector found. The difference of these two will show the difference of scale for the total number of logs, or the per cent of difference can be easily found. This variation may be as much as 1% in good timber, or even 2 or 2.1-2% in large, shaky hemlock, and be considered close, but if greater than that something is wrong.

The check scale often shows the variation on some individual logs to be very large in comparison with the total variation. This is due to differences in judgment of the seriousness of defects. It is impossible for two men, no matter how good scalers they may be, to agree on the scale of large, defective or partly rotten logs, but if several are scaled and one man’s scale varies back and forth with the other, the average will be very good and all that can be expected. The smaller differences are due to the reading of the rule. This is possible because of the system used of taking the nearest inch above or below the actual diameter as the scaling diameter. If the actual diameter is near the half inch, or the log is not exactly round, it is very easy for one to make a difference of one inch on the diameter, either above or below the other, thus making a difference of 10, 20 or even 50 feet on one log. These differences, however, always vary back and forth so they about balance if a large number of logs are taken as a check.

The method of checking up with each scaler every week or ten days 100 logs at a time is better than taking a larger number of logs at longer intervals. The usual 100 logs will be enough to equalize the difference due to reading the rule and if several defective logs are taken the scaler’s judgment of such logs can be obtained as well as if more were taken. This will always keep the scaler “on the job,” too, and doing his best, for he never knows when the inspector will be around or where he will select his logs for the check scale. A scaler can never slight his work or guess at the scale of the logs, for the inspector may find them. If a scaler averages too large a scale, even though it favors the Government, or the Indian, he is just as sure of being discharged as if his scale was too low.

When the area has all been logged over and the work is done for the season, several scalers are taken to each camp in turn, usually all of the scalers go together from camp to camp and make the “pick up” as it is called. This means that the crew goes over very carefully all of the area logged over during the
season and if there are any logs found that should have been taken they are scaled, stamped with the regulation U. S. hatchet and reported the same as the other logs. If the purchasing company wants to go over the area and remove these logs they have a perfect right to do so, otherwise they are left in the woods. This feature encourages closer utilization of the timber and insures cleaner work on the part of the company than could be gotten in any other way.

This does not complete the inspection, however, for the inspector may find an inspector from Washington in town any day, and have him go to the camps with him and check up both his work and that of the regular scaler. Usually the inspector and the Chief from Washington both scale the same logs, then check up with the scaler. If the scaler's scale does not agree with the inspector's scale, or with the Chief's scale, or the inspector's scale does not agree with the Chief's scale, something is wrong and someone will probably be fired, and you can be reasonably certain it will not be the Chief.
The Flora of Lake Vermillion
Minnesota.

L. H. PAMMEL, Ph. D.
Professor of Botany, Iowa State College.

Lake Vermillion is situated in the Northern portion of St. Louis county, north and a little east of Duluth and may be reached via the Duluth and Iron Range Railway. The lake is only 35 miles long, but it has 800 miles of shoreline. In many places the shoreline is rocky, in others, however, there are sandy beaches. The lake is noted for its many islands. Those who profess to know, state that there are 355. Some islands are only 100 feet square, while one of the large islands contains several thousand acres, including several small lakes. The depth of the lake varies from a few feet to 150 feet. At one time there was considerable timber in the region, mostly white pine (Pinus strobus), red pine (Pinus resinosa) and some Jack pine (Pinus divaricata). Paper birch (Betula papyrifera), balsam fir (Abies balsamea), Arbor vitae (Thuja occidentalis), tamarack (Larix laricina), white spruce (Picea canadensis), black spruce (P. mariana), black ash (Fraxinus nigra), and Balm of Gilead (Populus balsamifera) occur in swamps and along the streams. There is also Populus grandidentata on a few islands. Other species of trees occur but they are scarcely merchantable. These trees are as follows: Bass wood (Tilia americana), hard maple (Acer saccharum), red ash (Fraxinus Pennsylvanica), and green ash (F. Pennsylvanica var lanceolata). The pin cherry (Prunus pensylvanica) is common everywhere, especially in burnt-over areas. The choke cherries (P. virginiana) is also common, but never attains the dimensions of a tree. The quaking aspen (Populus tremuloides) is one of the common trees, never, however, of large size. Mountain ash (Pyrus Americana) is always a shrub or a very small tree. The oak (Quercus ellipsoidalis) is a rare tree occurring on Pine Island. The blue beach or iron wood (Carpinus caroliniana) was only found once at the lower end of the lake, near the Vermillion dam. It was shrublike and only leaves were observed. This locality makes apparently the most northern limit in Minnesota for the species. The speckled Alder (Alnus incana) is common in the swamps and on the shores of the lake. American elm (Ulmus americana) is confined to the streams and beaches of the lake.

The shrubs and herbaceous plants are important because of their relation to the growth of forest trees. The importance of the associated plants has been considered by many botanists. Woodsmen have often observed that when the associated plants are removed the forest trees are short lived. In conversation with Gus. Fabin, who owns a cottage at the head of Fabin's Bay, when the dying of balsam fir in front of his cottage was mentioned he said, "I have often noticed that when you remove the associated trees the balsam fir is a short lived tree."

The more important shrubs of the region are the following: (Salix amygdaloideas), on the beaches, not common. Cordate willow (Salix cordata), Sandbar willow (S. longifolia), bog willow (S. pedicellata), gaucous willow (S. discolor), beaked willow (S. rostrata), Sweet gale (Myrica gale), beaked hazel (Corylus rostrata), swamp birch (Betula pumila), June berry or service berry (Amelanchier spicata), Red raspberry (Rubus idaeus var aculeatisimus), dwarf raspberry (R. triflorus),
Birch and balsam in the Lake Vermillion region.

Beach in front of Fabin's cottage.
the table on the next page gives the percentage population of trees in the vicinity of Fabin's cottage and Birch Point, as well as the plant population in the vicinity of Tower and Sudan.

The associated shrubs and trees in the above areas are given in percentages. The mountain maple and dogwood are not always mentioned. A study of the table will show the different types of shrubs and the abundance of the same. The Muskeg swamp contains Picea mariana, Larix laricina, Betula pumila, and Alnus incana, the latter on the border. The following shrubby plants occur; Cameradaphne, Andromeda polifolia, Vaccinium macrocarpum. Such plants as Sarracenia purpurea, Carex filiformis and Spiranes. Sphagnum occurs scattered over the Muskeg.

The more important plants growing with the balsam fir, white pine, paper birch and quaking aspen are the following: Bush honeysuckle (Dieriva lonicera) with pale yellow flowers, the dwarf cornel (Cornus canadensis) with its bright red fruit, and the mountain maple (Acer spicatum) with its blue fruit early in August was conspicuous. In all of the recent clearings great quantities of Aster corymbosus were present. The trailing twin flower (Linnaea borealis), Smilacina bifolia, Rubus idaeus var. aculeatissimus, Lycopodium lucidulum and Pyrola secundula were common everywhere in the woods. The dogwood (Cornus circinata) on the shores of the lake and the red dogwood (C. stolonifera) in tamarack and spruce swamps. In a stage beyond the Muskeg one finds pools of water standing. These swamp contain the black ash, alder, balsam fir, Alisma plantago var. americana, Circula maculata, Glycera canadensis, Calamagrostis canadensis, wild calla (Calla palustris), and the swamp fly honeysuckle (Lonicera oblongifolia). In the upland woods the following species are common: the Currant (Ribes triste), Black currant (R. prostratum), Bishop's cap (Mitella nuda), Marsh marigold (Caltha palustris), Beech fern (Phegopteris dryopteris), Sensitive fern (Onoclea sensibilis), Willow (Salix rostrata), Alder (Alnus incana), Hydrocotyle americana, Geranium robertianum, Campanula aparinoideas, Lycopous americanus, Mentha canadensis, Pteris aquilina, Arctostaphylos uva-ursi, Lathyrus ochroleucus, Rattlesnake plantain (Epipactis pubescens), Bottle grass (Asprella hystrix), Uvularia grandiflora, Smilacina racemosa, Poison ivy (Rhus toxicodendron), Bitter Sweet (Celastrus scandens) and Virginia creeper (Pseudera quinquefolia). On the beaches the following plants are common: Sumach (Rhus glabra), Hair grass (Agrostis scabra), Strawberry (Fragaria virginiana), Rose (Rosa blanda), Columbine (Aquilegia canadensis), Red ash (Fraxinus pennsylvanica), occasionally Dogwood (Cornus stolonifera), and (Aspidium spinulosum) in woods back from beach.
<table>
<thead>
<tr>
<th>Species</th>
<th>Upland Near Fabin's Cottage</th>
<th>Swamp Near Fabin's Cottage</th>
<th>North Slope Birch Point</th>
<th>East End Birch Point</th>
<th>Near Birch Point</th>
<th>At the Very End of the Point</th>
<th>Schively Lower End of Lake</th>
<th>Muskok Swamp Border</th>
<th>Muskok Swamp Interior</th>
<th>Swamp at East End of Fabin's Bay</th>
<th>Pine Island Shore</th>
<th>Island of Finnes</th>
<th>Strawbery Island</th>
<th>East End of Fabin's Bay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinus mariana</td>
<td>5.97</td>
<td>16.12</td>
<td>16.65</td>
<td>0.99</td>
<td>3.64</td>
<td>20.00</td>
<td>33.76</td>
<td>4.29</td>
<td>10.14</td>
<td>8.55</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
<td>10.14</td>
</tr>
<tr>
<td>Abies balsamea</td>
<td>4.58</td>
<td>24.46</td>
<td>8.30</td>
<td>0.80</td>
<td>3.64</td>
<td>20.00</td>
<td>33.76</td>
<td>4.29</td>
<td>10.14</td>
<td>8.55</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
<td>10.14</td>
</tr>
<tr>
<td>Thuja occidentalis</td>
<td>3.66</td>
<td>16.07</td>
<td>16.65</td>
<td>0.80</td>
<td>3.64</td>
<td>20.00</td>
<td>33.76</td>
<td>4.29</td>
<td>10.14</td>
<td>8.55</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
<td>10.14</td>
</tr>
<tr>
<td>Pinus resinosa</td>
<td>4.58</td>
<td>24.46</td>
<td>8.30</td>
<td>0.80</td>
<td>3.64</td>
<td>20.00</td>
<td>33.76</td>
<td>4.29</td>
<td>10.14</td>
<td>8.55</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
<td>10.14</td>
</tr>
<tr>
<td>Pinus strobus</td>
<td>2.03</td>
<td>16.07</td>
<td>16.65</td>
<td>0.80</td>
<td>3.64</td>
<td>20.00</td>
<td>33.76</td>
<td>4.29</td>
<td>10.14</td>
<td>8.55</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
<td>10.14</td>
</tr>
<tr>
<td>Pinus diversaestra</td>
<td>3.43</td>
<td>25.30</td>
<td>8.30</td>
<td>0.80</td>
<td>3.64</td>
<td>20.00</td>
<td>33.76</td>
<td>4.29</td>
<td>10.14</td>
<td>8.55</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
<td>10.14</td>
</tr>
<tr>
<td>Larix laricina</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxus canadensis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Populus tremuloides</td>
<td>24.45</td>
<td>5.09</td>
<td>6.30</td>
<td>8.30</td>
<td>0.80</td>
<td>3.64</td>
<td>20.00</td>
<td>33.76</td>
<td>4.29</td>
<td>10.14</td>
<td>8.55</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
</tr>
<tr>
<td>Populus grandidentata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Betula papyrifera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Betula pumila</td>
<td>15.77</td>
<td>1.39</td>
<td>35.63</td>
<td>19.80</td>
<td>12.04</td>
<td>4.33</td>
<td>15.64</td>
<td>8.74</td>
<td>10.00</td>
<td>19.92</td>
<td>10.14</td>
<td>5.95</td>
<td>16.20</td>
<td>10.14</td>
</tr>
<tr>
<td>Acer saccharum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acer rubrum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acer spicatum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tilia americana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulmus americana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhamnus alnifolia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cornus caninata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corylus stolonifera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amelanchier spicata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prunus pennsylvanica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prunus virginiana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyrus americana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fraxinus nigra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fraxinus pennsylvanica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alnus incana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corylus rostrata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myrica Gale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salix rostrata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salix discolor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salix amygdaloides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salix pedicellaris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ledum groenlandicum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**—Peat Bog.
Pine Island, one of the large islands still has considerable standing white and Norway pine. Interspread with these species are the following trees: red maple, basswood, paper birch, balsam fir and arbor vitae. The undergrowth consists mainly of Cornus circinata, Corylus rostrata, Acer spicatum, and Diervilla lonicera. Near to the shore lines, Cornus stolonifera and Myrica gale. The herbaceous plants are much the same as on the mainland. Of the conspicuous plants mention may be made of Clintonia borealis, Arctostaphylos uva-ursi, Liannea borealis, Pyrola secunda, Equisetum sylvaticum, Vaccinium pennsylvanicum, Rhus toxicodendron.

Several small lakes occur on the island. In Bass Lake Nuphar advena was observed in abundance. On the shores there was an abundance of Iris versicolor, Sium cicutaeformium, Calla palustris and Calamagrostis canadensis. A small island lying a short distance from Birch Point, the Isle of Pines, contains some virgin white and Norway pines. The rock is near the surface. Of the plants observed mention may be made of the following: an abundance of Polytrichum juniperinum, Diervilla lonicera, Aspidium spinulosum, Pieris aquilina, and Poa serotina. Strawberry Island near Fabin's Bay and Birch Point has a much smaller area than the other islands. All of the virgin pine has been removed, young white spruce, white pine, arbor vitae are growing up thickly. The rock lies close to the surface. Poa serotina covered all of the vacant places. In dry places near the shore Rhus glabra, Gnaphalium, and Cladonia rangerferina. The Lycopodium dendroideum, Aster corymbosus, Rosa blanda, Cornus circinata, Diervilla lonicera, Hieracium canadense, Fragaria virginiana, Rubus idaeus var aculeatissimus, Epilobium spicatum, Vaccinium pennsylvanicum, Solidago ulmifolia, Ribes triste, Polygodium vulgare, Aspidium spinulosum, Pyrola secunda, Prunus virginiana, and Prunus pennsylvanica. All of these islands soon become covered with vegetation after a fire.

The lower end of the lake at the dam contains an interesting lot of plants; Clintonia borealis, Eupatorium purpureum, Polygonatum biflorum, Smilacina racemosa, Asplenium Filix-femina, Aspidium noveboracense, Impatiens fulva, Aspidium spinulosum, Castalia odorata, Nuphar advena, Scirpus lacustris, Scirpus atrovirescens, Lemna trisulca, Aster umbellatus, Solidago serotina, and Viburnum opulusfollum.

Some of the introduced plants found in the vicinity of Birch Point, Schively and Tower are as follows: Cirsium arvense, Iva xanthifolia, Helianthus annuus, Russian thistle (Salsola kali var tenuifolia), Nepeta Cataria, Tanacetum vulgare, Artemisia biennis, Xanthium canadense, Erigeron canadensis, Phleum pratense, Trifolium repens, T. pratense, T. hybridum, and Rumex crispus.

No attempt is made to give any of the literature bearing on the plants of the region. It will only be necessary to refer to two papers, the most important of which is by J. C. Arthur, which includes the botanical work of Holway, Arthur, Bailey and Upham who did work in the region in the eighties. Their camp was located in 48° north latitude near Lake Vermillion. The trees and shrubs of the region are given by F. C. Otis, C. Otto, Rosendahl and F. K. Butters in their Minnesota Trees and Shrubs.

L. H. Bailey in the above contribution lists the white ash (Fraxinus

---

**Report of the Botanical Survey IX.
The burr oak (Quercus macrocarpa). If these species occur, the writer did not observe them. The author is quite sure that the white ash (Fraxinus americana) does not occur in the region. I am quite certain that the species barely extends into Minnesota. Arthur, Holway and Bailey do not report this ash in the list of plants between Lake Superior and the International Boundary.

C. R. Van Hise and C. K. Leith who discuss the geology of the Lake Superior region state that the lakes of the region are generally parallel to the trend of the ridges and generally longer than broad.
Carrying Capacity of Ranges in Western United States

R. L. HENSEL, B. S. F.
In Charge, Santa Rita Range Reserve.

Few persons realize the importance, necessity and far reaching results of proper range management. There was a time on the Western ranges when 2 or 3 acres of grass land would support a cow or horse. At the present time, 20 to 30 acres per head are needed on the same area. Had the stockman of those days applied some of the principles his neighboring farmers were applying, perhaps unknowingly, he would have maintained the productivity of the range and would have benefited the present generation in lower beef prices. However, let it be said in defense of the cattleman of that day, he was only human. Perhaps anyone seeing the wonderful and abundant forage which covered the West, would have been prompted with the same "get-rich-quick" motives and have exploited the range to its capacity and over and then left the future to care for itself. Years after the ranges were overstocked, state legislatures passed various laws concerning the grazing of stock on public ranges and finally, with the creation of National Forests, many ranges came under the more rational systems now being used by the Forest Service. In a way, it is safe to say that the methods of handling stock are still in their infancy and are still extensive although some of them are called "intensive."

Carrying capacity may be roughly defined as being the number of stock that a range can carry without any depreciation in amount of forage. Indeed, at the present time it goes farther. The aim not only is not to have any depreciation in amount of forage but to try to increase the amount up to the point where it rightfully belongs. To do this there are several factors which enter into the discussion. They are:

- Accessibility or nearness to water.
- Topography.
- Length of time range can be grazed.
- Character of vegetation.
- Economic conditions nearby.
- Diseases and natural foes.

Regardless of how abundant the forage is or how palatable, it has no value unless there is water within reasonable distance. This distance varies in different regions and is affected by the humidity of the air to a very large extent. In Oregon cattle will not travel very readily over about 3 miles to water. In
southern Arizona cattle have been known to travel over 13 miles to water and this every 36 hours in a climate that is exceedingly torrid. It is quite possible to have water so located that all parts of a range will be equally fed, but this is very seldom the case. Usually the intensity of grazing decreases with increase of distance from water. Water is as essential as feed itself. Very often stock will eat plants near water that they will not touch at a greater distance from water. For instance, sheep will eat hellebore near watering places and bedding grounds, but they would not touch it at some distance or where other forage is present. In connection with the discussion concerning water it might be well to state that more and more the importance of good, pure water is coming to be realized. Many stockmen even warm the water in the winter. The older stockmen seemed to think that as long as mud and muck was thin enough to drink it was good enough for any kind of stock.

A level plain would represent an ideal grazing ground to the novice, but here again there is room for argument. A level plain, provided that the yearly temperatures were agreeable and that enough forage and area were available to rotate the different parts, would approach the ideal, but a plain with nearby high mountains forms the best range. On the Wallowa National Forest in Oregon differences in elevation ranged from 900 feet to almost 10,000 feet with corresponding vegetation. This really forms an ideal system, for stock can graze the low elevations in winter and gradually move up towards higher elevations as the snow melts and then return when the first snow falls in the autumn. Of course, there are some drawbacks to this system, but they cannot be enumerated here. However, the point that should be emphasized in this paragraph is this—regardless of whether there is feed and water, the range cannot be used if it is not accessible. Take a case of a mountain side covered with the best of grasses and with abundant water, but beset with steep cliffs and slides for a part of its area so that stock could not safely use it. Until trails and driveways are built, it would be largely a waste range. Very often there are ranges that would make good forage for one class of animals while another would starve. This would be true of goat ranges; sheep or horses or even cattle would starve to death on some goat ranges. This then would be considered an inaccessible forage, if there were no goats to feed it. To get the full forage value and carrying capacity out of a piece of range, then, one must consider its accessibility.

In the warmer parts of this country there are yearlong ranges. That is, grasses and weeds are accessible to stock in winter as well as in summer. This, then, makes the harvesting of crops to feed in the winter unnecessary as is the case when snow
covers the ground for a large part of the winter. It does bring in a similar condition and that is, having some forage to be consumed during the winter. This can be done by fencing off an area or cutting down the number of animals so that enough forage will be on hand to carry them through the winter. If this is not done a condition will prevail which exists in this particular section at present. No reserve food supply was or ever is left and when a dry, cold winter comes and is followed by a late spring, cattle losses are heavy. To overcome such a system, a series of pastures can be put in and “rotated” like the Iowa and Illinois farmer rotates his fields and crops. In the case of the Wallowa National Forest, there were 4 classes of ranges, although only 2 were recognized—winter and summer. To these could be added spring and fall. In a case of this kind the summer range period would last not over 2 months, while the spring and fall periods would probably be the longest, depending on the season. One year in eastern Oregon the season consisted of 2 months spring and 10 months winter.

Character of vegetation determines the kind of stock that can best use the range. For instance, sheep will eat hackberry and thrive on it. Horses and cattle will barely eat it unless forced to. Therefore, it would be a waste of forage to try to make cattle and horses feed on hackberry range when sheep will eat it readily. The same holds true of coarser grasses. Sheep are careful about what they eat. They prefer tender shoots and flowers. They eat grasses but do not care for coarser ones, especially when they are dried or “cured.” Now, cattle and horses are fond of grasses and eat cured grass as readily as green. Under proper conditions they do better on dried grass than on green. Therefore, if there is a range that is at its best in the fall and is composed of coarse grasses, it should be fed to cattle and horses—while green and tender it can be lightly grazed by sheep. When possible, the range should be so arranged that the right class of stock uses the range best suited to that class of animals.

Under economic conditions nearby, there should be considered the activities that persons living near any particular piece of range are engaged in. For instance, several large farmers living next a piece of range, have each several head of cattle and horses. The range might be better sheep range, but these men do not have enough stock to warrant moving them on to regular cattle range, so they are put on the wrong class of range adjoining their ranches. Very often this makes necessary a large waste of forage, for it takes more acres of sheep range to run a cow than it does to run a corresponding number of sheep. Also a small sheep man living in a cattle country wants his sheep to range near his ranch, so he runs his sheep in the cattle range. As he gets more sheep and can keep a herder, he may very likely move his stock to a sheep range.
Most stock are susceptible to some disease or other and steps must be taken to prevent their occurrence and spread. In connection with cattle some excellent preventatives have been used. For blackleg many stockmen are now using vaccine and their losses have been cut down noticeably. The very best of ranges are not immune from some diseases and in order to obtain the maximum carrying capacity, measures must be taken to prevent their spread. Very often these diseases are communicated to man as, for example, the "Mountain fever," which is so fatal to man and which is transmitted by ticks. Among natural foes are coyotes, wolves and lions. In one region it was impossible to raise colts for 13 years because mountain lions were so abundant. In the southwest wolves bother stockmen appreciably despite the efforts of the Biological Survey to eradicate them. Coyotes create considerable havoc with sheep and goats, often killing them merely for the pleasure they derive from it and not through necessity. It will be easily understood how a range on which predatory animals are abundant will affect the carrying capacity. Under this heading we may also include poisonous plants. Many are doubtless aware that the Forest Service posts conspicuous warnings in badly infested areas. On one range alone 40 head of cows were counted that had died of poisoning, and the end was not yet in sight. This condition was affecting the carrying capacity by making it necessary to remove the stock to other areas. If nothing is done, it will be necessary to consider the area as waste, inaccessible or undesirable range, or put on some class of stock that is immune to this particular plant.

After having taken the foregoing points into consideration, the amount of forage present must be known and from this can be determined how many animals the area will carry. This is rather a cut and try affair. In a short while the maximum carrying capacity for a range can be determined. When stock are properly watered, salted and distributed, it is possible to increase the carrying capacity from 10 to 100 per cent. Ten per cent may seem a small figure. However, when it is considered that in 1914 there were 1,508,639 cattle on forest ranges and add 10 per cent, giving an increase of 150,863, which at $30.00 per head for yearling yields a monetary increase of over $4,500,000, it is an item worth while. In some cases a 10 per cent increase may mean only a cow or 2 on an allotment, nevertheless, they all represent dollars and cents.

At the present time the Forest Service has experiments started in which problems in carrying capacity and range management are being studied in detail. Range reconnaissance is nothing more than a step toward increased capacity and more efficient range management. It would be impossible for one, in the short space allotted, to go into the very large number of points which come up in a grazing reconnaissance or in the making of a graz-
ing working plan. On the Santa Rita Range Reserve the plans cover about 20 typewritten pages and there are only about 32,-
000 acres to deal with. The plan here is essentially one in which
the forage is allowed to mature its seed before stock are permit-
ted to graze it. In this way the continuance of the present stand
of forage is assured and the natural reseeding is provided for
by allowing plants to go to seed.

In conclusion, the writer feels safe in saying that the next
10 years will see a great change take place in the method of
handling stock on public ranges. This change will originate with
the Forest Service and in time will be voluntarily taken up on
private holdings.
A Summer's Work on a Forest Service Experiment Station

A. S. HENRY, B. S. F.

The question often comes up in the mind of the student of Forestry, as to what branch or phase of his profession he will specialize in. During the last few years the growth of Forestry as a profession has been rapid and from the comparatively limited field of a few years ago, it has developed into an occupation of many and broad possibilities. The lumberman is coming to see that his timber supply will become exhausted unless closer utilization is practised. The steam and electric railroads and the telephone and telegraph companies are beginning to realize the great saving that will be effected by the use of preservative treated wood. The cities are becoming aware of the value of their park and shade trees and the necessity of conserving them. The Government Forest Service attracts perhaps more men of the forestry profession than does any other single field of activity. One of the most important as well as interesting branches of Forest Service work is that carried on at the various Government Experiment Stations.

A field season spent in practical work gives a student an opportunity to judge of the possibilities his training offers. A summer spent on experimental work gives one a glimpse of the value and economic application that such work has. The Utah Experiment station, located near Ephraim, Utah, on the Manti National Forest, is typical of this kind of work.

It seems to be the accepted view of some, who view the forest from a lumber producing standpoint solely, that the grazing industry is a necessary evil, rather than one of great importance. That this idea is erroneous can readily be seen, from the fact that approximately one-half the revenue derived from the forest service is secured from grazing fees.

The livestock industry is one of the main sources of wealth in the locality of the Utah Experiment Station. The Manti National Forest forms the summer range for a large number of sheep and cattle. The lumber industry is of less importance, the revenue received from grazing fees much exceeding that obtained from timber sales.

Before this region was converted into a national forest reserve, it was grazed as were many other localities in the western country, ruthlessly and with no thought of the future value of the range. Each owner was desirous of securing the best grazing ground for his flock of sheep and the consequent struggle which ensued
was detrimental not only to the stock but to the range as well. The inevitable result of this practice was that the range became overgrazed. It was to remedy this state of affairs that this section of the country was made into a forest reserve.

In order to determine how best to restore the depleted range, experimental studies were begun. The studies are carried on in what is known as the spruce-fir type at an elevation of from 8,000 to 10,000 feet. The top of the ranges are well rounded and are covered with vegetation. The areas where experimental studies are carried on are places that have been overgrazed in the past. Vegetative reproduction is less vigorous here and as a result much erosion has taken place.

Restoration of the range to its original productive capacity with the least economic loss from non-use is desired. This, as shown in the "Natural Revegetation of Range Lands Based Upon Growth Requirements and Life History of the Vegetation," by A. W. Sampson, is best secured by the deferred system of grazing, "which aims at a rotation in the time of using each portion of the range, each year allowing an area to reach seed maturity before it is cropped, but grazing after that period, in order to avoid loss of forage through non-use and to assist reproduction by trampling in the seed." In carrying out this policy grazing is restricted from the areas upon which experiments are carried on until August 20, when the seeds of most of the forage plants have ripened. Revegetational studies to best determine the method of retaining the valuable forage plants, which are the first to disappear when overgrazing is practiced, are made. These studies include a life history study of the most important forage plants.

The collection of a plant herbarium is carried on in connection with this work. The plants are collected as they reach maturity. Three specimens of each species are collected. One specimen is kept for the Experiment Station, one for the supervisor's herbarium and one specimen is sent to the Washington office. In collecting specimens the following points are observed: (1) date of collection; (2) botanical name; (3) common name; (4) exact locality where collected; (5) altitude; (6) slope; (7) soil character; (8) associated species; (9) classes of stock grazing the plant as forage; (10) value as a forage plant; (12) abundance; (13) distribution.

At an elevation approximately the same as where the experiments are carried on, climatological records are kept. These include a daily record of the temperature secured from a thermograph and the variations in temperature by the maximum and minimum thermometers. Readings are made of the soil temperature at 6, 12 and 18 inches, of the humidity, of the evaporation and of the wind velocity. The amount of precipitation and ex-
tent of sunshine each day are recorded. A correlation between these factors and plant growth may then be drawn.

The San Pete valley, into which Ephraim canyon opens, is dependent for its water supply, to grow its crops, upon the water that flows down from the mountains above. A large part of this moisture comes from the snow, which melts off slowly during the summer and maintains a constant supply. The success of the farm crops is dependent upon a plentiful supply of moisture during their growing period. Wherever a forest cover is removed from a steep slope the result will be heavy erosion and frequent floods. The removal of the forest cover allows the moisture to run off rapidly and very little of it is able to find its way into the soil. A vegetative cover will tend to check erosion in the same manner as does the humus and litter in a forest floor. Overgrazing will cause a less dense vegetative ground cover.

In order to afford a comparison between the amount of run-off and erosion upon a grazed and ungrazed area, experimental plots, typical of the locality, are grazed for a number of years. During that time a complete record is kept of total precipitation, rain and snow, and the amount of run-off and erosion. All the precipitation that falls on these experimental areas flows over a weir where it is recorded by means of a float and gage. The sediment settles to the bottom of receiving tanks where it is measured. At the end of a certain interval the area will be closed from grazing and the records continued. A comparison of the results secured will show the value of a vegetative cover in preventing erosion and heavy floods.

About all the timber in this region important from an economic standpoint is found between 5,500 to 9,000 feet in elevation. Between these elevations are included three of Merriam's climatic zones; namely the Upper Sonoran zone, the Transition zone and the Canadian zone.

The Upper Sonoran zone (Pinon cedar type) extends from 5,540 to 6,500 feet in elevation. The characteristic flora of this type is pinon pine (Pinus edulis), western yellow pine (Pinus ponderosa) found along the stream courses, single leaf pinon (Pinus monophylla), two junipers (Juniperus utahensis) (Juniperus scopulorum), narrow leaf cottonwood (Populus angustifolia), scrub oak, (Quercus Gambellii), sagebrush (Artemesia tridentata), rabbit brush (Chrysothamnus nauseosus).

The Transition zone (Oak type) extends from 6,500 to 7,500 feet. The important species are western yellow pine, Colorado blue spruce (Picea Paryana), Douglas fir (Pseudotsuga taxifolia), white fir (Abies concolor), Rocky Mountain birch (Betula fontinalis), maple (Acer grandidentatum), scrub oak, bitter brush
A SUMMER'S WORK ON EXPERIMENT STATION

(Purshia tridentata), manzanita (Arctostaphylos uva-ursi) and mountain mahogany. (Cercocarpus parvifolius.)

The Canadian zone (Douglas fir type) lies between 7,500 and 9,000 feet. The important plants of this zone are Douglas fir, White fir, Colorado blue spruce, balsam fir (Abies lasiocarpa), common juniper (Juniperus communis), limber pine, (Pinus flexilis), quaking aspen (Populus tremuloides), Acer grandidentatum, Rocky Mountain maple (Acer glabrum), chokecherry (Prunus melanocarpa), wolfberry (Symphori carpos occidentalis) and mountain maple (Pachystima myrsinites).

Coniferous plantations are located in various parts of these zones. They are planted in different sites and on different soil with varying conditions of shade. Examinations of these are made one in the Spring and one in the Fall. The examination consists in plotting the species on a chart and noting the number living, dead or missing, their condition, weak or vigorous and the amount of growth the preceding season.

Aspen and coniferous reproduction studies, seed collection, nursery work, collecting soil samples, collection of an herbarium, the laying out of sample experimental plots and other special studies are some of the other phases of experimental work.

A field season spent at experimental work is a profitable one. It is instructive because it requires close application and a regard for detail. It serves to develop originality in treating with unexpected problems and it is interesting because of the very nature of the work itself.
Directory of Forestry Alumni

Board, Lynn—ex '19. Hudson, Iowa. Foreman of Forest Nursery, Fort Hays Branch Experiment Station.
Cronin, L. J. Sibley, Iowa.
Dallmus, Karl—ex '19. Strawberry Point, Iowa.
Hansel, Harry—'15. Ottumwa, Iowa. Assistant County Engineer.
U. S. Forest Service.
Iowa National Guard.
Isch, D. H.—ex ’17. West Bend, Iowa.
Teaching High School.
Koepke, W. C. Information wanted.
Forest Examiner, Products Division, District Office.
Valparaiso University.
Ranger, U. S. Forest Service.
Aviation Corps.
Mast, W. H.—’00 (Yale ’05). Davenport, Iowa.
Davenport Nursery work.
Coast Artillery.
Lumber Camp No. 16.
Forest Examiner, Coconino National Forest.
Planting Reconnaissance, St. Joe National Forest.
Coast Artillery.
Parks, L. S. Phoenix, Arizona.
Agriculture Inspector, U. S. Reclamation Service.
Ray, F. C. Des Moines, Iowa.
Ray Coal Company.
Forest Assistant, Minnesota National Forest.
Ringlehm, H. I.—’12. Dumbline, Saskatchewan, Canada.
Manager of Retail Lumber Yards.
Pheips Landscape Company.
Sage, H. H.—’15. Information wanted.
Schmidt, H. O.—ex ’17. Renville, Minnesota.
Superior National Forest.
Aviation Corps.
Smith, R. F.—’15. Information wanted.
Smith, W. A.—’12. Ogden, Utah.
Superintendent of Canning Mill.
Smith, P. T.—'11. Deadwood, South Dakota.
   Forest Examiner, Black Hills National Forest.
   Forest Examiner, Wallowa National Forest.
   Blackwell Lumber Company.
   Yard Foreman, Willapa Lumber Company.
   Forest Examiner.
Warner, D. H.—ex '18. 1315 Filmore St., Des Moines, Iowa.
   Coast Artillery.
Whitham, J. C.—'11. Camp Crook, South Dakota.
   Supervisor, Sioux National Forest.
   Ranger, Plumas National Forest.
Wilkins, J. P.—ex '19. Monticello, Iowa.
   Asst. Forest Ranger, Bonneville National Forest.
   Hardware and Timberman's Supply Store.
   Tie Treating Plant, C. & N. W. Ry.
Seven Thousand Miles With Ames Foresters

G. B. MACDONALD, M. F.
Professor of Forestry, Iowa State College.

The 1917 summer trip taken by the Ames forestry students was made through Iowa, Nebraska, Colorado, Utah, Nevada, California, Oregon, Washington, Idaho, Montana, North Dakota and Minnesota. The class was in the field for 12 weeks under the direction of 3 members of the forestry faculty. The students had an opportunity to observe the principal timber types in all the important lumber regions of western United States as well as to make detailed studies of logging and milling operations. During the trip 3 Forest Service Experimental Stations, several nurseries, and 14 National Forests were visited. The trip was made at a relatively small expense to the students. Camps were established at the different stops and, except in a few cases, meals were served in camp.

The Forest Service officials of the many National Forests visited went out of their way to be of service to the class—which made the trip both pleasant and profitable.

The following shows the schedule of the trip:

June 7—Left Ames.
June 8—Arrived at Denver, Colorado. After an hour the class left for Palmer Lake. A walk of 4 miles brought the class to the Monument Nursery, where several hours were spent looking over the nursery operations under the charge of Mr. Schrader.
June 8-10—Arrived at Manitou in the evening and made camp near the “cog station.” The first day was taken up with a trip on foot to the Fremont Experiment Station, where the class was given the details of the experimental work carried on at the station by Mr. Nelson, in charge. The second day was spent by most of the party in walking to the summit of Pike’s Peak.

June 11-15—Red Cliff, Colorado. The stay here was spent in making silvicultural, mill, and logging studies. Forest Ranger Gustafson piloted the class to the interesting points on the forest. Camp was established just outside the town and the various members of the class tried camp cooking for the first time.

June 15—Glenwood Springs, Colorado. A stop between trains was made and the class enjoyed a swim in the big hot spring plunge.

June 16. Soldiers Summit, Utah. A stop of one day here enabled the class to take a silvicultural and dendrological trip through the timber of that locality.
June 17. Salt Lake City, Utah. The interesting points of the city were visited during a few hours stop between trains.

June 18. En route through Nevada.

June 19-20. Portola, California. This stop of two days was made on the eastern border of the Plumas National Forest in the Yellow Pine country. Forest Ranger Nail was detailed to assist the class at this point. Studies were made of the timber and of the milling and logging operations of the Feather River Lumber Company.

June 21-27. Quincy, California. At this stop the Feather River experiment station was visited. Some work in fighting a forest fire was experienced. The class was taken over the forest by Supervisor Rogers and Forest Examiner Taylor. Interesting observations were made on reproduction and management.

June 28-29. Los Angeles, California. A day spent in sight seeing.

June 30-July 1. Redwood Park, California. Parts of two days were spent on a hiking trip from Boulder to Redwood Park. Here a fine grove of large redwoods was seen.

July 2. San Francisco, California. The day was taken for seeing the city.

July 3-7. Sisson, California. Under the guidance of Supervisor Hammitt observations were made of planted areas. A trip was made to the top of Mt. Eddy, where a modern lookout was established.

July 8-10. Cottage Grove, Oregon. Two days were taken in the vicinity studying logging operations of a large lumber company.

July 11. Portland, Oregon. A stop over night was made at the "Rose City."

July 11-30. Wind River Nursery, Carson, Washington. This was the longest stop of the trip. Camp was made at the Wind River Nursery where good bunk houses and a modern mess house were put at the disposal of the camp. Detailed studies were made of the large nursery. A splendid opportunity was afforded to study the timber types of the Northwest. The operations of the Wind River Lumber Company were also studied. A timber estimate was made, fire plans studied and much information was gathered on the experimental work of the Wind River Experiment Station. Mr. Hofman, in charge of the station, and Ranger Cline gave the class valuable assistance.

July 30. Columbia and Portland. The trip from Carson to Portland was made by boat.

July 31. Oregon City and Portland. A part of the day was spent in the big mill of the Willamette Paper Company.

August 2-5. Sultan to Index, Washington. Under the piloting of Ranger Mortimer the class took a 70 mile inspection trip
through the Snoqualmie National Forest. Near Index a modern logging operation was visited.
August 7-12. Fernwood, Idaho. Visited the box mill and saw mill of the Milwaukee Railroad. Several days were spent at Camp 16 of the Blackwell Lumber Company.
August 15. Spent in an overland hike from camp to St. Joe and St. Maries.
August 18. Libby, Montana. A day was spent in the saw mill of the Libby Lumber Company. Supervisor Smith, of the Kootenai National Forest served as guide to the class.
August 19-23. Glacier National Park. The class took a 4-days hiking trip through Glacier Park, looking from Belton to Glacier Park Station, by way of Lake MacDonald, Gunsight Pass, Piegan Pass and Many Glaciers. The 4-days hike covered 115 miles.
August 24. En route to Cass Lake, Minnesota.
August 25-28. Cass Lake, Minnesota. Four days were spent on the Minnesota National Forest on silvicultural, planting, nursery and mill studies. Forest Supervisor Marshall and Forest Examiner Richmond assisted at this stop.
August 29. Cloquet, Minnesota. The mill of the Great Northern Paper Company was visited, and a trip was made to the Cloquet Experiment Station, under the direction of Mr. Kenety.
August 30. Duluth, Minnesota.
August 31. Minneapolis, Minnesota.
September 1. Ames, Iowa.
The Ames forestry class on the first stop of the Western trip, at the Forest Service Nursery at Monument, Colorado. At this point the class had an opportunity to look over the nursery operations of the Forest Service in this region.

The Ames foresters making a detailed study of the Forest Nursery at Monument, Colorado. Mr. Schrader, the nursery foreman, is explaining the seed-bed methods to the class.
The forestry class at the experimental nursery at the Fremont Experiment Station in Colorado.

The class making camp on arrival at Soldiers Summit, Utah.
Ames foresters making reproduction studies in yellow pine, and Jeffrey pine on the Plumas National Forest in California.

Taking notes on logging on the Plumas National Forest, California.
The foresters making a study of the logging methods in the California woods.

The class at the Forest Lookout Station on Mount Eddy, in California. Here the class had an opportunity to look over detailed fire protection plans.
The Ames foresters in action, cutting fire wood for the camp, Wind River Experiment Station, Columbia National Forest in Oregon.

The class taking lessons in shake making on the Columbia National Forest, Oregon.
The class in the woods at Cottage Grove, Oregon.

Leaving the Columbia National Forest by way of the Columbia River, Portland.
Lined up for a timber estimating trip in northern Idaho in the famous Western white pine region.

A view of Piegan Pass, Glacier National Park. One of the many beautiful views seen on the 115-mile hiking trip through this park.
A part of the Ames forestry class on the Minnesota National Forest.

Some of the rugged scenery encountered by the forestry class in the Glacier National Park, Montana.
The foresters on their way to the Fremont Experiment Station on the slopes of Pike's Peak.

A portion of the class on an inspection trip on the Plumas National Forest in California. In the center is shown a Jeffrey pine tree.

Forest Ranger Nail, who served as guide for the forestry class on an inspection trip on the Plumas National Forest at Portola, California. The picture shows Jeffrey pine bark and cone characters.

A pause in the Redwood State Park, California, where the class had an opportunity to observe some of the largest trees in the country.
A short stop was made at Big Tree Station, California. Here the class had an opportunity to see some fine redwood timber. The high redwood stump shown in the picture has two thrifty sprouts each over a foot in diameter.

In the Pacific Northwest the forestry class had an opportunity to study in detail some of the largest sawmills in the country. The picture shows the Jack ladder in the big Weyerhauser Mill at Everett, Washington.

A portion of the class on a timber cruise on the Columbia National Forest in Washington. Tree shown is Douglas fir.

During the Western trip the forestry class had a splendid opportunity to study at close hand practically all of the important commercial timber trees of the West. The picture shows the bark characters and cones of sugar pine.
The class on an inspection trip through the Snoqualmie Forest in northern Washington. The trip is in charge of Forest Ranger Mortimer.

Some of the rugged scenery encountered by the forestry class on the overland trip through the Snoqualmie National Forest. A burnt-over area in the foreground.

Professor Truax, Forest Ranger Mortimer, of the Snoqualmie, and Ames foresters, waiting on the Great Northern at Index, Washington.

The class making an inspection of a Lidgerwood log skidder on an operation of the Blackwell Lumber Company, Idaho.
During the Western trip the forestry class had an opportunity to see the finest stands of the famous Western white pine in the United States. A Western white pine specimen taken on the St. Joe Forest in northern Idaho.

On the Glacier Park hiking trip, View shows a hanging glacier.

Some Alpine scenery on the Glacier Park hiking trip.

View on the trip from Piegan Pass to Many Glaciers in Glacier National Park. The view shows Grinnell Lake, Grinnell Falls and a portion of Grinnell Glacier.
A part of the forestry class at the big lumber center in Cloquet, Minn.