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FOREST MANAGEMENT IN SOUTHERN PINES.

Opportunities for foresters to secure employment with lumber companies in the southern pine region are beginning to develop. But as yet the duties required of a man holding such a position in the United States are indefinite in character and but slightly understood. For this reason, the eighteen months' experience of the writer as forester for a large lumber company, logging Loblolly Pine and other species at Hell Hole Swamp near Charleston, S. C. may prove of interest, as illustrating in one case what was expected of the forester and how the problems which arose were handled.

On my arrival at Hell Hole Swamp, Mr. C. S. Chapman, who had made a working plan for the tract, was busy instructing a tree marker to mark all pines above 14 inch D. B. H. Soon the writer was left alone to bear the inquisitive scrutiny of the natives, who knew only that we were trying to keep out fires, that I was the "fireman." Necessarily the prevention of fires was the first work to be undertaken. But how to obtain protection? A man who never had this problem to solve probably does not see the danger and does not worry, but after some experience when he realizes that at any minute 10 or 100 acres of the finest reproduction may be destroyed, he understands that to *keep fire out* is, in the South, the most vital and troublesome part of a forester's work. To this problem, therefore, I shall devote the larger space.

The freeing of the negroes and the invention of matches are the causes underlying the setting of forest fires in this region. Before the war when rice culture was booming and the land was owned entirely by intelligent rice planters, special stress was laid on keeping the woods "rough" (dense). Indeed, the woods were kept so "rough" that one could hardly see a deer unless it jumped

over a road. The purpose of keeping the woods in this condition was to favor the raising of cattle and perhaps on certain areas with a view of raising hoop poles. The fact that on the same area 25 cows were then raised to one now, and that not half as many died in the spring, is not yet realized by the modern cattle raiser.

In contrast to the North where the fire danger lasts only for a few months, in the South protection is needed through the whole year. In character, the fires are ground or grass fires, except in very dry seasons when the swamps dry out and then the humus itself may burn, and with it the lateral roots of the pine and cypress. After such injury these trees are blown down by the first wind; while the red maple which grows in the swamps falls down and covers the ground even before any wind blows.

The effective system of protection finally adopted may be outlined as follows:

1. A good saddle *horse* (bought at the forester's expense!) is indispensable to cover ground quickly and become acquainted with the ground. Horses raised in the woods which know how to travel through swamps and open woods and do not weigh over 900 pounds are the best.

2. A detailed *knowledge of the whole tract,* must then be obtained, locating all places which need immediate protection, noting the distances between certain points, observing every road, slough, swamp and little creek, and even the cow and hog trails, (for the purpose of back firing). This involved a lot of riding, and it took me half a year to become familiar with the tract of about 45,000 acres.

3. The *boundary line* not being visible, it was made the first work to locate it by painting white or red rings on trees along the line. This was needed to prevent fighting fires on another man's land, to facilitate patroling service, to note the adjacent areas where fires must be stopped, and to know the people living around the tract.

4. An effort was made to establish *friendly relations* with the natives because four-fifths of the fires could be kept out if their co-operation was obtained. The fires are set mainly by the cattle and sheep men, who inherit the bad habit of burning the woods during March, and by coon and "fire" hunters. I never

threatened to report the hunter found shooting in the closed season, but rather instructed him to be careful with the fire pan, or even hunted with him and, by example, taught him to be careful about fires. Many cattlemen tried to make me believe that the fires in this country are set by careless people and negroes who did not own any cows, but I proved them wrong since most of the fires occur at one and the same time of the year (in March), whereas, if the fires were set by careless people or those indifferent to stock interests, they would occur at any time of the year. Since these men believe that they cannot do without a burning I made agreements to burn every February several acres near their houses, a so-called "calf" or "tick" burning, which suited both parties. This worked all right and afterwards we were not much bothered with fires.

5. On dangerous days after the dew was gone fire *patrolling* was done by two good men. This patrol was needed about 300 days a year. These patrol men should live on a road, or near places which need special protection. They should be men who are respected, or even feared, and who have few enemies. It is not necessary that the patrolmen be always strolling around the tract, they can do a certain amount of work every day, as *e. g.* the girdling of dogwood or rotten hardwoods (where this is required) or the chopping down of myrtle bushes. This latter is best done with a sort of a chisel on a handle 5 feet long so that the myrtle drops from the stump and remains standing up. If it bends or falls over, many pine seedlings are injured. An axe cannot be used for this work, as more pine than myrtle would be chopped down. Myrtle is a bad weed to contend with, although it sheds many leaves which keep the grass growth off and prevent high flames; but it retards considerably the height growth which is needed so badly in order to bring the pines in the shortest time to a height where fire protection is not needed. A herd of goats is doing good service in keeping down myrtle and other bushes.

6. A *handcar* on the logging road was found to be a necessity to carry the men and tools to work, or quickly to a fire. In observing a fire shining on the sky at night, the distance may be very deceptive if one has no experience. But by a ride of two miles on the car up or down the track, observations may be made

of the bearings of the fire from each end of the route, and its location can be accurately obtained by intersection, and time can be saved in reaching the exact spot.

7. The *tools* needed for hoeing fire lines and fighting fires are: A good small steel hoe costing 85 cents, and a file with which to sharpen the hoe; a good axe, and a double bitted axe, one sharp side to chop logs, the other blade for roots; a cross-cut saw with hollow back (to prevent bad pinching); a brush hook; a rake about 10 inches wide with long prongs. The rake should not be too wide or it catches between roots. The handle of the rake frequently gets loose when the lower part is burned. To prevent this, each rake should be fixed with a wire so that when it gets loose the rake will stay on the handle.

These small items are important, for nothing is so annoying when fighting fire as bad tools which may break at a critical moment. A dozen or more handles made of light wood should be kept on hand. Other wood, as ash or black gum, springs when green, and a man when hoeing fire lines the whole day becomes tired using such a handle. Avoid big and cheap rice hoes, as they bend and do not keep sharp.

8. *Fire lines* are effective aids in controlling fires. Aside from roads, creeks and swamps, two kinds of fire lines are to be distinguished, namely, hoed lines and burned lines. The hoed fire lines are the safest and in the end the cheapest. The width used was 4 feet, the cost averaged one cent per pace. Straight lines in the form of a hollow furrow were marked out with a hoe and then hoeing was commenced on both sides. The ground, loosened by the hoeing, was raked into the grass; and in this way the grass close to the line was covered up, really making the line wider. This prevents high flames close to the line and keeps hogs from rooting back the dirt into the line. It is advisable to make the lines perpendicular to the direction of the prevailing wind.

Before staking out a line for the protection of several hundred acres, one must go thoroughly over the ground, especially around the edges, to find out the best place to which to tie on the line, as to a swamp, a creek, or a road. Otherwise the fire may work around the line. Old railroad tracks and cable roads as a rule should be selected as fire lines since there are no tops or other

obstacles to clear away, the removal of which often makes the construction of lines expensive.

Lines should be hoed over in September when the grass stops growing, and after December first when the leaves have fallen. From this time until May, the lines must be kept clean, being frequently swept with a broom, or raked. Wind and heavy rains bring leaves and pine needles into the lines, and when the water evaporates the needles mark the water line and give a chance for fire to cross the line. Cattle and hogs will travel on the lines, which improves them. All dead trees with rotting sap within 100 paces of the line should be cut or the ground around them raked clear, for if they catch fire they may throw sparks across the line.

Fire lines along main lines of railroads should be hoed 100 paces from the track on both sides and the space between burned when the wind blows toward the track. Most fires start close to the track from cinders blown from the ash pan on windy days. A spark arrester for wood firing engines, made in Indiana, proved a total failure when lightwood was burned, because soot closed the holes of the wire and stopped the draught. They may be applicable where oak and other hardwoods are burned, but they cannot be used in the southern pine belt.*

Burned lines are satisfactory along property lines and in longleaf pine stands. Since here the width of the line does not affect the cost much, it can be made fom 10—30 paces wide. Dead trees outside the area to be protected must be cut and along property lines this may be done on the neighboring tract.

The important question is how to burn the lines. One man with a hoe scrapes a furrow on the side of the line toward which the fire will blow. A large bunch of dead grass or needles is then gathered and drawn along with a rake on the other side of the line and the fire set in this. If the fire burns away from the line it is whipped out with the top of a longleaf or loblolly pine sapling. A sack soaked in water is another good tool to whip out fire. Where there is longleaf pine litter, a strip is raked on both sides of the line before firing. The best time for burning is toward evening or at night. Never burn on bright windy days. When the fire runs away from the line more damage than good

*See description of an efficient spark arrester in this issue, p. 98.

is done. To prevent accidental fires, burned lines should be made on both sides of much traveled roads to the distance of 5 paces from the edge of the road. This is especially needed where many negroes pass, as they frequently build little fires on cool mornings.

The disadvantages of burned lines are that they are good only for one season and are dangerous to burn. Moreover, some spots will not burn, as for example, through a little slough or around ponds, and to prevent fire from crossing in a dry time after the water has evaporated these spots must be burned over in a separate operation.

9. Experience has shown that protection on each area should not start *until the lumbering is completed;* but the area to be cut during the succeeding year should be burned each winter, otherwise it is impossible to prevent fire around the steam skidders. If the grass is not burned before the trees are cut, the slash fires are very hot and may kill seed trees and other polewood. Besides the engines and skidders there are many other dangers while lumbering is in progress. First the tie cutter in cooking his dinner may leave a fire burning, then comes the right of way cutter, and later the sawyer who will surely burn the grass to kill the rattlesnakes. For three reasons the grass ought to be burned before lumbering: 1. It makes the cutting of the right of way cheaper. 2. It reduces the danger of cordwood stacked along the track for the engine being burned up. 3. It facilitates the marking of seed trees.

The only work necessary on the cut-over areas is the removal of the slash from around the seed trees, chopping into the sap of standing dead trees, and finally the burning of all the debris. When all this is done and the railroad track has been removed, then, and then only fire protection should commence.

To repeat briefly: First burn the grass before the timber is cut, then burn the slash, and finally protect the cutover land.

On places where the cutover area remained "rough" by accident and good reproduction has started, it is hard to secure protection on account of the unburned slash. If a fire runs through such land, it is very hot and kills everything outright. Such burned areas will not recover for 10 years. Grass takes possession of the ground and seedlings only start singly and develop in bushy form. Yet there are places where it is justifiable to leave

cutover areas "rough." This is true of isolated pine islands where the skidder remained only for one set up, usually at the end of the track. To secure protection here, a man must watch the skidder until the skidding is finished. Such islands surrounded by swamps have a chance of remaining unburned for many years.

10. For *how long* a period is protection *required?* The young Loblolly Pine thickets need protection until they are twelve feet high. A maximum of about eight years is required for the reproduction to attain this size. With seed trees present it takes from one to three years, according to site quality, for the seedlings to become established and reach the height of one foot. Five years more must elapse before a height of twelve feet is reached. When the thicket is twelve feet high the first judicious burning takes place. The time must be carefully selected and the burning should be done against the wind. Select either the time just after a rain, when the litter is superficially dry, or a cloudy calm day in January or February, or night for the burning. Blocks of from ten to thirty acres only should be burned over at one time. By this fire very few pines will be thinned out, but nine-tenths of the fire danger has passed. Definite results will soon be available from permanent sample plots established on this tract.

The time when fire hurts seedlings at least two to three feet high is in spring when the new buds are about one inch long. At the same time, when hurt in winter the seedlings have no recuperative power at all. This may be due to the fact that the bark when the sap is "up" does not heat as much as in winter when the sap is "down."

Cost of Protection. For $1,000 a year the area logged by three steam skidders can be protected, provided that the fire protection commences a year after the lumbering is started and the money is spent regularly every year after that time. Do not hesitate to spend money on patrolling service, especially during March, for while it may cost $300 or more, the results secured justify the expenditure.

Notes on Management.

The management of Loblolly Pine stands depends on the method of lumbering and the admixture of other species. Here

the lumbering is done with steam skidders and in cutting the trees no wedges are employed. Both practices, and especially the skidder cable, when the sap is up and in big timber, are destructive to trees of smaller diameters. Small trees of fourteen or even sixteen inches D. B. H. are present only in patches or are not of the desired species. Another very important factor is the slackness of the logging superintendent towards the saw bosses in regard to the rules about "cutting marked trees only" and "low stumps."

The presence of Pond Pine as an inferior species in the forest also has an influence on the management of Loblolly Pine. Pond Pine in number of trees comprises 50 per cent. and in volume over thirty per cent. of the Loblolly Pine stands. It is mixed singly or in strips and occurs in belts around savannas. When interspersed singly or in strips, Loblolly Pines are the largest trees, hence the ordinary lumbering leaves Pond Pine as unprofitable trees to cut, or as seed trees. The result can be seen everywhere in South Carolina and Georgia, that Pond Pine forms the second crop, or the future stand. When it forms a belt around savannas it is almost pure, Loblolly Pine being only of scattered occurrence. The reason why Pond Pine takes possession of such areas is, aside from the site quality, that it resists better than Loblolly the heavy grass fires, and moreover it has the capacity to sprout; frequently even Pond Pine cross-ties can be seen sprouting. All these factors made the rigid diameter limit method unsuccessful, and its use out of the question so long as the forester is not the logging superintendent. I am afraid this point will not be fully appreciated.

A method involving less work and that to be done by the forester himself, because each acre needs his judgment, must be devised. The marking of trees above 14 inches D. B. H. was done formerly by one man at a cost of $35.00 per month. This system has now been changed to the following scheme: Three men, each provided with a pail of whitewash and a brush or pine twig, paint a white ring around each seed tree, and put on two white spots below stump height to identify the seed trees if they should be cut. One day's work per week is sufficient to keep ahead of three steam skidders. I, myself, picked out each seed tree, and trained the men to learn to distinguish the Loblolly from the Pond Pine.

One strip 100 paces wide can be marked at the same time. As seed trees were selected trees 12 inches and over in D. B. H. which were not liable to be smashed by big trees leaning towards them and were not burned at the butt. The number per acre varied from one to three, depending on the size of the seed tree, the admixture of Pond Pine, and the relative danger from fire due to the nature of the underbrush and the locality. One good-sized Loblolly Pine per acre is sufficient to start a good reproduction after the ground has been wounded and ploughed up by the skidding of logs. But in case after two or three years a fire should kill the young seedlings, then the conditions for germination would be only a fraction as favorable as immediately after lumbering, and more than one tree per acre would be required. In patches such as old rice fields which have grown up since the war and which contain much Loblolly of small diameters, no marking or cutting was done. In swamps and along their edges where Loblolly reproduces best the old trees decrease in number, and it would be best not to cut any pine. Just the reverse, however, was done, all the pine being cut and the hardwoods left. The logs from the tract are towed 50 miles to the mill and the hardwoods would sink, hence they are not cut. One large pine ought to be left near each set up of the skidder, because, as a rule, for two acres around the skidder the ground looks as if it had been ploughed. It would be a good plan to collect some seeds in October each year and to sow them on such places.

Experience has taught that our method of tree marking has secured excellent reproduction.

If the diameter limit method is not used how will the sustained yield called for in the working plan be secured? The seed trees were to be considered as an intermittent yield and the young pine seedlings originating from the seed trees as the second crop. But the seed trees can not be utilized without doing great damage to the young second crop and hence must be left standing. So the second crop will consist of the second growth and the mother trees. There will be nothing to harvest except here and there, until the present crop of seedlings is mature. Therefore, calculations on second crop can be based only on good silviculture, and not on figures. *The most successful forester will be he who is able to raise a thrifty young growth!*

Opportunities for Planting.

The open savannas with high grass and open stands of short-boled pines where reproduction comes too slowly—and fires are frequent—are at present unproductive lands. Planting of Loblolly Pine is the only way to bring such areas under forest without a long period of costly protection. Young seedlings could be raised in plots on the ground, or better, taken from the woods in places where the soil is loose, as under Dogwood. The planting should be done on rainy days in strips, 50 paces wide, and the strips 100 paces apart, for the present time. I have planted one acre with seedlings one foot high. Of course, the grass must be burned for several years around the planted strips.

The savannas grown up with thicket and usually covered with almost stagnant water offer another chance for planting. Such thickets must be first burned over in a dry time. This would temporarily destroy the thick undergrowth. Meanwhile cottonwood cuttings can be planted which will outgrow the thicket and ought finally to shade out the bushes, or even to a certain extent drain the savannah. Cottonwood already grows scatteringly in such places. There were 3,000 cuttings ordered for this purpose, but at the time of the writer's departure they had not arrived.

Management of Longleaf Pine.

The only way to secure and raise Longleaf Pine is to keep hogs off the tract. They are ten times worse than fire. In the case of this tree judicious burning, for example burning on a winter night, would make fire altogether harmless for the young seedlings. But the hogs eat nothing but seedlings during the winter. They root them out and eat the part just above the root. And before another seed year (five year intervals) occurs, the last seedling of the previous crop is chewed up. The danger done by hogs could be well demonstrated by fencing off a small area and comparing reproduction inside and outside of the fence.

Max Rothkugel.

PLANTING ON NEW MEXICO FOREST RESERVES.

Few states have a greater need for reserve planting and intensive utilization of forest products than New Mexico. Areas capable of supporting high-class timber growth are confined to a few mountain ranges and are small in extent compared with the size of the region dependent upon them. Moreover, the Territory is remote from the great forest centers and should be made as self-supporting as possible.

Lumber values have risen steadily during the last decade and prices for the better grades are already prohibitive to poor people. Wood of all sorts, including the poorest of the native species used for fuel supply, is in high demand. Careful management which will prevent wasteful utilization of the remaining supplies and maintain the best possible stands of growing timber will materially benefit the entire Territory. Such action will be of especial benefit to the agriculturists and miners, who form a very large percentage of the population.

Water supply is considered the most important factor in future development. Considerable study has been given to this question by the Reclamation Service, various city authorities, and those interested in ranching. Increase in population and further development of natural resources depend very largely upon better regulation and increase of flow, and in more conservative use of the available water.

All the forest reserves have been well selected to serve their purpose. They have been located at the headwaters of many of the most important streams and usually where the timber was being rapidly removed by short-sighted or unscrupulous operators. But the mere creation of the reserve is not sufficient. To maintain the proper balance in the development of the various industries it is necessary that the present forest be managed from the most conservative standpoint. As far as practical it is essential that all understocked forest areas and all forest land lacking tree growth should be made more highly productive.

Reproduction varies in each reserve. The principal influences limiting it in the past have been over-grazing and fire. Climatic conditions also limit reproduction to a considerable extent over the entire Territory. Seed years of most species occur at inter-

vals rather than annually and, since unusually severe climatic conditions may prevail during these seed years, there may be almost an entire lack of reproduction for a considerable period. Satisfactory reproduction depends on good seed crops followed by favorable climatic conditions. Even during the most favorable years, however, the season of drought, which lasts from the time the snow melts in spring until some time in July, or early August, limits seedling growth considerably.

Artificial forestation, then, becomes necessary on a large scale. In the most important of the various reserves different objects in planting assume various degrees of prominence. These depend on the general requirements of people in and about the reserves and, to a greater extent, on the prevailing site conditions.

Gila Forest Reserve.

A planting station under competent technical supervision has already been established on the Gila Forest Reserve. This station is intended primarily to supply seedlings for planting on the watershed which supplies Fort Bayard. This particular planting area is quite limited in extent and is covered with an open stand of pinon, junipers, and scrub oak. The project becomes of more than ordinary importance, however, because of the heavy expense incurred by the Department of War in establishing and maintaining Fort Bayard as a sanitarium for the treatment of tuberculosis, for which within recent years the water supply has proven inadequate. The Department of War and the Forest Service are co-operating to the fullest extent in improving the water supply. With the entire exclusion of grazing, and considerable forest planting it is thought that the water supply will be materially increased and made adequate for all demands at the Fort.

The nursery was established in the spring of 1905, and at present occupies nine-tenths of an acre. Two hundred thousand two-year-old Bull Pine have been transplanted in the nursery and field planting will be started during the coming year. The work is especially interesting since seedlings of all the species planted have made a very satisfactory growth, even on the heavy adobe soil. Field planting will be much more difficult on this watershed than on most of the other proposed reserve planting pro-

jects, since climatic conditions are more severe and the soil is shallow, rocky, and largely a heavy adobe.

During the past field season detailed examinations were made of the Lincoln, Jemez, and Pecos River Forest Reserves. Several large sites on which forest planting is highly advisable were selected. All of these projects show considerable variation in character and in each of the reserves the need of planting and the expected results are entirely distinct and should be treated separately.

Lincoln Forest Reserve.

The Lincoln Forest Reserve probably illustrates the need of reserve planting more fully than any other reserve in the Territory. It was created on account of the protective value of the forest on stream flow and to conserve the limited timber supply. These become of more than usual importance when consideration is given to the fact that the reserve and adjoining areas are thickly populated. Before the creation of the reserve, surface fires had been common and had materially reduced reproduction. Added to this was the severe grazing to which the reserve was subjected. Naturally there has been a wide diversity in the use of timber by the numerous settlers. Portions of the reserve are honeycombed with mining claims, all of which show some timber cutting. In a large number the entire stand has been removed. In accessible coves and on favorable slopes some lumbering has been done. All classes of settlers used the reserve supply for fuel, posts, and construction timbers, and were usually wasteful in their methods of exploitation. The creation of a reserve to protect small owners and retain an efficient forest cover was preeminently necessary.

But the creation and conservative management of the reserve are not sufficient to supply all present needs, secure good regulation of run-off, and provide for the future. The forest* at low elevations and on moderately level land, is an open stand of Pinon Pine, Alligator, Juniper, One-seeded Juniper, and Gamble Oak. Open stands of Bull Pine occur on slopes at moderate elevations, while Englemann Spruce occurs in limited dense stands at

* See "Forest Conditions in the Lincoln Forest Reserve, New Mexico," by F. G. Plummer and M. G. Gowsell, U. S. Geological Survey.

high elevations. On the whole it is a forest in which there is a remarkably large proportion of low-class material.

The sanitarium at Fort Stanton requires 1,200 cords of wood per year from reserve land. Naturally the large number of settlers secure a considerable amount under "free use permit." Already there is a scarcity of the dead and down timber which has furnished these supplies. It seems impossible that the present stand of live timber will prove adequate in supplying future demands and at the same time retain a sufficient forest cover.

There is also strong need for an improved water supply. The Rio Bonito and Rio Ruidoso watersheds comprise one-third of the reserve lands and furnish a large percentage of the water available for the Hondo irrigation project. Besides this, the numerous ranchers along these stream courses are practically dependent upon this water supply for their entire support. Analyses of soil from the valley of the Hondo show a greater fertility than the famous valley of the Nile, and only a very small fractional increase in total water supply will necessarily mean a large increase in the productiveness of the region. Owing to decreased forest cover, floods have been increasing in frequency and severity during the last ten to fifteen years, and there is considerable local demand for flood prevention.

An added need for better water supply and greater timber production is caused by the recent influx of settlers who intend to practice "dry farming" or a system of partial "dry farming."* Many of these farmers who use intelligence in selection of sites will undoubtedly succeed and become permanent settlers. This has already caused an increased demand on the timber supply of this reserve. Moreover, this system of agriculture depends to a large extent on conserving all moisture which results from natural sub-irrigation. Since the forest increases the amount of water available for such irrigation, the condition of forest cover is bound to have considerable influence on the success of such farms in and adjoining the reserve.

There is, then, a stong and diversified demand for forest planting on this reserve. The field investigation was carried on with three main considerations in view. 1. The improvement of existing forest. 2. The enlargement of the forested area. 3. The

*Modified Campbell system of "dry farming."

determination methods which will insure success in forest planting.

The Improvement of Existing Forests.

At least two-thirds of the drainage basin of the Rio Bonito and Rio Ruidoso is forested with open, understocked stands. Cutting is more permissible on level or moderately level areas than on slopes, where there is greater danger of injury to site. A large proportion of this woodland is stocked with *Juniperus pachyphloea* and *Juniperus monosperma,* and natural reproduction will have to be depended upon to a considerable extent, since artificial propagation of these species is difficult. Pinôn, Gamble Oak, and suitable introduced species should be planted experimentally, however. Site conditions because of a denser soil are as a rule less favorable for planting on the level than on the slope lands.

Slope land comprises an immense area, and is covered with a scattering stand of Bull Pine, Scrub Oak, or a mixture of the two. Many of these sites have supported dense stands in the past and the examination proves that practically all are capable of maintaining a better class of forest growth. Close comparative examination of sites shows that many of the best stands of slope timber are growing over areas where the soil and the amount of moisture supplied are identical with that of brush land or of the sparsely timbered areas. Conditions are so closely similar that it is advised that all slopes which are now lacking timber growth should be planted in the near future. Bull Pine, with a possible understory of Gamble Oak, seems best adapted to this site, and will, if planted, accomplish the desired results.

The Enlargement of the Forested Area.

There are thirty or thirty-five sections of land entirely lacking timber growth, with the exception of small areas covered with brush and an occasional individual tree, or small groves of conifers. Most of this land is covered with a stand of broad-leaved mountain grasses, though grama grass is found in limited sections. This open land, located largely on slopes, is one of the direct causes of the frequent floods. The soil on these sites varies from the usual adobe two to three feet in depth to a shallow gravel of granitic origin. Similar soil and exposure prevail

over large areas of timber land. Furthermore, where there are occasional seed trees, as on Loma Grande, limited natural reproduction occurs. From these indications it is believed that forest planting can be accomplished with satisfactory results. The annual precipitation amounts to seventeen to eighteen inches at stations lower in elevation than the planting sites.

The Possible Success of Forest Planting.

In all cases it is aimed to start work on sites which are in great need of planting and at the same time afford the greatest natural advantages. Planting should begin on protected slopes where soil and moisture conditions are most favorable, but it should be limited in extent until the best methods are determined for carrying on the work extensively. Over most of this area it is thought that Bull Pine, Mexican White Pine, Red Fir and Gamble Oak will prove the most satisfactory indigenous species. *Robinia neo-mexicana* should be tried on north slopes. It is hoped that some introduced species will prove more satisfactory than any of the native species and the following have been recommended for trial: Incense Cedar, Sugar Pine, Scotch Pine, Austrian Pine, *Pinus muricata* and *Pinus contorta.*

Jemez Forest Reserve.

This reserve contains the best body of Bull Pine south of Idaho. At high elevations there are excellent stands of Engelmann Spruce with slight mixtures of Red Fir and White Fir. The reserve is considered of greater importance for timber supply than for protection, although its value in this latter respect is great.

The northern portion of the original reserve and a large portion of the recent Tres Piedras addition have been burned over by ancient forest fires. These fires have almost entirely destroyed the dense coniferous forests which formerly prevailed over the entire area. The burned area covers about twenty-two sections lying west of the Chama mountains, and also comprises nearly two-thirds of the drainage area of the Rio Antonio and its tributary the Rio Los Pinos.* Clear cutting for lumbering

*This river received its name from dense pine forests which grew formerly upon its banks.

was carried on over the rest of this drainage basin. The result is that out of two hundred thirty sections originally forested only fifteen to twenty sections retain a dense stand of conifers. Possibly one-fourth to one-third of the drainage basin is covered with a second growth forest of Aspen and Scrub Oak which is of decided inferior value compared with the previous stand. Aside from the small area of coniferous forest and this poor woodland, the remaining portion of the watershed is entirely lacking in timber growth.

Grasses and sedges have followed all fires. A species of *Carex* (probably) grows over the mesa land at high elevations, and forms in most cases a complete ground cover. Slopes are largely characterized by several species of bunch grass but are frequently over-grazed and in need of forestation to prevent erosion. On most of the burned area there is still considerable fallen timber. Judging from this and the uninjured stands on this area, as well as on the Tierra Amarilla grant, the original stand must have frequently reached 25 M board feet per acre, and an average of at least 5 M board feet per acre. The soil varies from four to sixteen inches in depth on mesa land, and from three to five feet at the bases of slopes. Most of it has an adobe base.

Forest planting is advisable from several standpoints. This area once supported the highest type of coniferous forest and could do so again, thus furnishing a timber supply which would be of great future value to New Mexico and Colorado. Incidentally the forest growth would materially benefit water supply. The watershed adjoins the Denver & Rio Grande Railroad, contains numerous roads and is easy of access for a mountainous country. Natural regeneration in and about the small stands of living timber is entirely insufficient. Finally, planting can be carried on for several years with little or no interference to the present industry of sheep grazing.

It is recommended that Bull Pine be planted over moderately level areas and on south slopes up to an elevation of nine thousand feet. On north slopes and at high elevations Engelmann Spruce, Red Fir, and White Fir are recommended, with preference for the first named species. Very small stands of dense reproduction occur on both these classes of sites where seed trees

have been left, and where the seedlings have been given a fair chance for growth. These small stands of reproduction combined with excellent site conditions show the possibilities of forest planting in this region.

The Pecos River Forest Reserve.

The work advised on the Pecos River Reserve is much more limited in extent. It is confined to city watersheds, and planting will undoubtedly prove difficult. Santa Fe Creek, with its headwaters in the western portion of the reserve, supplies water to Santa Fe; while the Rio Gallinas, with headwaters in the eastern portion of the reserve, serves a like purpose for Las Vegas. Most of the planting areas are at high elevations or on areas where the soil conditions are unfavorable. In both cities, however, there is a strong demand for improved water supply. This necessitates planting, even though the possibilities of success are not as great on these areas as is the case in the Jemez Reserve and on portions of the available sites in the Lincoln Reserve.

Conclusion.

Forest planting is essential to the proper development of the Territory of New Mexico. The degree of watershed development and suitable supply of forest products will determine to a great extent the future prosperity of the region. Present forests in most cases are inadequate on account of the limited area and a comparatively low productiveness. Forest planting, so planned that the forests will be improved and extended presents the only means of meeting the increasing demand for forest products and also lays the foundation for a proper watershed development.

Success in forest planting depends upon the solution of purely technical problems. Proper methods can not be developed without extensive experiments, on the ground, with a wide range of species. Climatic conditions are such that only the most painstaking work, regardless of method, can give hope of good results. Planting at various seasons will be required in order to determine the time at which trees may be planted with least injury from seasonal drought. Satisfactory plans for the future can be made only with such means as a foundation.

The expense of planting in the near future will be necessarily high. A fair demonstration of the relative merits of various

species under different forms of treatment should be the first aim. Only when this has been determined will it be essential to confine the cost of planting to the lowest amount possible.

FRANK J. PHILLIPS.

RAILROAD FOREST PLANTATIONS.

Some Mistakes Made in Establishing Them.

For a number of years there has been considerable discussion on the part of the railroads about the decreasing supply of cross-tie and construction material. In most cases they have taken no active steps to provide for a future supply and when measures were taken these were usually misdirected, costly and unsatisfactory.

Stone, brick, concrete and steel have partially replaced wood for many purposes such as bridges, culverts, station houses, cars, etc., but notwithstanding this substitution the consumption of timber by railroads rapidly increases each year. So far, steel, concrete, or other similar forms of cross-ties, of which many have been invented, are not as yet considered by American engineers as satisfactory substitutes for the wooden cross-tie most in use.

It is possible, as many claim, that steel ties are not adapted for use in the United States, but in the various tests made in this country frequently the prejudices of the parties directly interested were not laid aside and the ties given a fair and impartial trial. Although the superior officials of the railroad sanctioned the test, the subordinates who actually performed the work have usually had no faith in the undertaking, and their very attitude was such as to insure the failure of the experiment.

Among the objections offered by railroad engineers against the use of steel cross-ties may be mentioned the following: They are hard on the rolling stock because the track is so rigid that it does not yield to the weight of the passing train as it does when wooden ties are used; they do not hold firmly to the ballast; they have a tendency to become brittle and break when subject to heavy traffic; the track is expensive to keep in repair, and the first cost of the ties is now too great to warrant their use.

For these reasons, real or imaginary, railroad engineers strongly favor wooden cross-ties and will continue to do so until a marked improvement is made in existing substitutes.

For a large array of facts that steel ties have elsewhere given satisfaction, over 35,000 miles of steel track being in existence, see Bulletin 9 Forestry Division.

The timber resources of the United States upon which the

railroads must depend for their supply of cross-ties have now become so depleted that not only has the quality become inferior and the price higher, but difficulty is experienced by railroads, in non-forested regions, in securing a sufficient number of cross-ties for their needs. Necessity, therefore, has forced the railroads to give thought to the source of their future supply, and for this reason they have become interested in practical forestry.

About thirty years ago, as a result of a propaganda work conducted by ardent enthusiasts of forestry, some interest was aroused among railroads. The conservative management of woodlands was unknown and advocates of forestry urged the people to plant trees to replace the forests which were being recklessly exploited by lumbermen.

The first efforts, in fact all efforts up to the present time, have been devoted, therefore, to establishing forest plantations because this was the measure advocated at first by those interested in the subject of forestry. This idea has been a hard one to overcome, and it is only during the past year that a prominent railroad, for the first time in the history of forestry in the United States, has determined to acquire and manage forest lands for the production of cross-ties.

Many mistakes were made in establishing a growth not only in early plantations but in the more recent ones, because the railroads were ill-advised as to the relative merits of the various tree species suitable for producing cross-ties, the methods of cultivation demanded by the different soils in the various parts of the country and the care required by the plantations in order to insure success.

The interest of the individual railroads has, with a few exceptions, been enlisted through the personal efforts of enthusiastic but non-technical men who have placed before railroad men, busy with the conduct of a road, a scheme which was neither adapted to their needs nor practical. In other business matters men who conduct the affairs of railroads have shown business ability, but in matters pertaining to forestry they usually have shown poor business judgment and have engaged in forest work under impossible conditions, because they have allowed themselves to be influenced by men who do not come to them as properly accredited foresters. Quick results are desired, and the man who comes be-

fore them with a proposition to plant trees which in 15 years will produce several cross-ties and fence posts per tree can secure their attention and enlist their interest far more easily and quickly than a named forester who tells them that such results can be secured only after a longer period has elapsed. Time and dearly bought experience have proved to some of the railroads that satisfactory results cannot be secured from the plantations in a few years.

The importance of the selection of proper species for planting has not been given due consideration. Trees should be selected which will furnish a tie of considerable hardness, and the tree from which the cross-tie is cut should be of comparatively rapid growth, and be capable of renewing itself readily after cutting in order that a new crop may be quickly and cheaply secured.

With the heavy motive power and rolling stock and the high speed now attained, cross-ties are subjected to considerable wear under the rail. This may be overcome in softer woods to a considerable extent, by the use of suitable tie plates, but on curves and other places where the strain is greatest a soft tie cannot be used with safety.

Rapidity of growth and ease of reproduction while important factors should not be given too much weight over hardness; such species as the *Ailanthus, Paulownia* and others possess these qualities, but are totally unfit for use as cross-ties, the wood being too soft. In general it may be said that satisfactory cross-ties cannot be produced in the United States in less than thirty or forty years.

Durability in contact with the ground is not so important as the factors above mentioned because this quality may be secured at a comparatively low cost by means of chemical preservatives.

Many tree species in the various parts of the United States are adapted, to a certain degree at least, for the production of cross-ties. Notwithstanding this, in making the majority of railroad plantations, only two species have been used, and for various reasons they are among the least desirable of the species eligible for this purpose.

These two species are Catalpa and Black Locust and the reasons for their selection are not difficult to discover. The selection of the first species may be attributed largely to the

wide advertising the tree has received at the hands of ardent admirers who had and apparently still have, unbounded faith in the possibilities of the tree. Unfortunately they were able to convince certain railroad officials that Catalpa cross-ties possessed all the good qualities which cross-ties should possess, and none of the faults; and that in a period of fifteen years, each tree planted would produce five cross-ties and other valuable material.

Under favorable soil and climatic conditions, Catalpa, when properly cultivated, makes a rapid growth, but so far has never produced the cross-ties within the period named. Catalpa has been planted for many years, on a great variety of soils and on a wide range of territory, and although many plantations have reached an age of 25 years or more, so far as known, the trees in none of the plantations have reached a size suitable for cross-ties. The tree is well adapted for pole and fence post production in a short rotation. In regions where fence posts are high in price, farmers may profitably devote a very small portion of the richer soil of their farm to such purposes, but past experience has well demonstrated, that on the class of soils usually devoted to forest growth, Catalpa cannot be grown, advantageously, for cross-ties.

This tree requires a rich, fresh, well drained soil, and since such soils are well adapted for agricultural purposes, railroads will find that they cannot afford to hold such lands for forest purposes, when cheaper lands can be secured. The poor soils may not produce timber in the same length of time, nor in as large quantities as the rich soils, but the cheapened cost of production when the inferior soils are used, far more than offsets the time and extra yield gained by the use of agricultural lands.

A number of the large Catalpa plantations made by railroads have failed of their purpose, because the silvical characteristics of the tree and their relation to the physical character of the soil were not understood.

The plantation of the Illinois Central Railroad at DuQuoin, Illinois, offers a good example of this. The plantation was established some years ago on a fine, poorly drained silt soil. A portion of this site was covered with Pin Oak (*Quercus palustris*), Post Oak (*Q. minor*), Sweet Gum (*Liquidambar styra-*

ciflua) and other trees capable of enduring the existing soil conditions. Land in the vicinity is poorly adapted for agricultural purposes and only small crops reward the diligent efforts of the farmer.

The site is totally unfit for Catalpa because of the excessive soil moisture, and the trees have made a very poor growth. The trees in this plantation, the latter about 200 acres in extent, were planted at a large expense and will never reach cross-tie size, the only yield which can be secured will be a comparatively small number of posts.

Ignorance of the silvical characteristics of the tree has also been displayed in Eastern Virginia, where the Norfolk and Western Railroad owns several thousand acres at Ivor along its right of way. These lands were acquired for fuel purposes many years ago when wood-burning locomotives were in use on the railroad. Although good cross-ties can now be secured by this railroad at a reasonable price, the officials, because somewhat interested in the production of cross-ties and having heard much of the rapid growth of Catalpa, determined to establish small experiment plantations. The land is largely covered with an excellent growth of Loblolly Pine (*P. taeda*), a tree extensively used for cross-ties in Texas and other Southern States, but not yet in demand for this purpose in Virginia. The permanent water table is only 18 to 24 inches below the surface, making the site an unfavorable one for Catalpa.

With considerable labor 16 acres of land were cleared of the pine and the few Sweet Gum and Water Oak which stood upon them, and Catalpa trees were planted, at a large cost. The plantation was visited by the writer during the summer of 1905, a few months after the trees had been planted, and the foliage of the majority of the trees looked yellow and sick.

Had the railroad been properly advised, they would have understood that the conditions were distinctly unfavorable for Catalpa, and that Loblolly Pine could be grown on the land at a greater profit than any other tree. In fact this pine will rapidly re-seed the area and crowd out the Catalpa unless steps are taken to prevent the encroachment of the surrounding forest.

A further instance may be cited of the plantation made by the Illinois Central Railroad at Harahan, Louisiana. The soil con-

sists of a rich alluvial deposit and was formerly employed for agricultural purposes. Louisiana is outside the natural range of Catalpa, and the tree when planted in this region, where the growing season is long, and the soil very rich, made such rapid growth that the wood was so weak and "cheesy" that it was unable to support the heavy foliage of the tree. Winds have broken the weak stems and many trees in the plantation have become mere broken poles. On less fertile soil the tree might have grown successfully but under existing conditions the plantation is not a success.

Various other instances where extremely poor judgment has been exhibited might be mentioned, and in nearly all cases the significant fact is evident that the physical character of the soil has been disregarded in the selection of sites for Catalpa plantations.

It is scarcely credible that a body of men usually conservative in business affairs should be ready and willing to expend, freely, large sums of money upon projects about which they are not properly informed. A study and analysis of the propositions placed before them, or consultation of any trained forester would have saved them from needless expense and costly mistakes because any one acquainted with tree growth and especially with the Catalpa could have informed them that the latter can not be grown profitably on all classes of soil and over a very wide range of climatic conditions. Some railroads have discovered the mistakes they have made and now appreciate that the large profits and quick returns promised from Catalpa plantations partake too much of the nature of our present "get rich quick" schemes to place much reliance upon them.

The only extensive plantations of Black Locust made by railroads have been established in the State of Pennsylvania by the Pennsylvania Railroad. This railroad owns numerous tracts of land along its right of way which have been acquired during improvement of the roadbed or for the purpose of controlling some watershed from which water for the motive power and for the shops are secured.

Many of the former tracts consist of portions of farms which at one time were used for agricultural purposes and under

ordinary conditions would be more valuable for that purpose than for forestry.

The railroad frequently secured more lands than were needed for the purpose of improvement, because usually a whole farm could be purchased for a sum but little in excess of the cost of damages which the Company would be forced to pay for a portion of the farm. In some cases also it was found advisable to acquire lands in order to do away with objectionable rights. The policy of the railroad has been to refrain from leasing or selling these lands, and since the railroad itself carries on no agricultural operations, the lands remained unproductive until a few years ago when the subject of planting these lands to trees capable of producing material for cross-ties was taken under consideration.

In selecting a species for planting several important factors were overlooked, one of which is of sufficient importance to render the work already done of questionable value. The railroad had sufficient foresight to select an indigenous species, but the choice of Black Locust in preference to other native species shows that the selection was not made after a careful study of the merits of all the tree species eligible for the desired purpose. Black Locust is a hard wood, durable in contact with the soil, but in tracks which are not well drained and ballasted, difficulty is experienced in removing and respiking seasoned ties when the track has been disarranged by the heaving action of frost. However, ties made from this wood are very satisfactory, when they can be secured and, if available in sufficient quantities improved methods of spiking would be devised. Although the tree is a rapid grower and thrives on a variety of soils, it is so subject to the attack of an insect (*Cyllene robiniae*) that trees seldom reach a sufficiently large size to make cross-ties. Trees which do reach this size are usually so weakened by numerous cavities made by the borings of the insects that the wood cannot be used with safety.

Due to ignorance the railroad believed that it was planting "Yellow" Locust and not "Black" Locust. It was claimed that the former was not only a different species but the wood was superior and more free from the attacks of the locust borer. There may be some difference in the character of the wood

of Black Locust when grown on different sites, but it is a well known fact that the Yellow Locust and Black Locust are not distinct species, and it is questionable if the wood from any one tree is more free from insect attacks than that from any other. Throughout the State of Pennsylvania the locust borer occurs in greater or less numbers wherever the Black Locust tree grows and although the trees are attacked to a greater extent in some regions than in others, there does not appear to be any reason for the belief held by some that the condition of partial immunity is permanent.

Many instances were seen in Pennsylvania where the natural growth of Black Locust from three to four inches in diameter were badly attacked by locust borers, and already the insects have appeared in the earlier plantations which have reached this size. The indications are that as rapidly as the planted trees reach this size, they will become infested, and although it is quite certain that some trees will reach a size sufficiently large for cross ties, yet it is equally certain that the yield of ties secured from these plantations will be insignificant in comparison to the yield which might have been secured by the exercise of the same amount of time, energy and money, had more suitable species been used.

Entomologists have not discovered any practical method of combating this insect, and until a suitable scheme is devised, it is unwise for any person or corporation to expend large sums of money in planting this tree, for the failure of the enterprise can be foretold in advance.

The region in which the plantations are located is adapted to the growth of Chestnut, Red Oak and many other trees, and on soil suited for their growth it is a better policy to encourage the formation of forests of the first two species, either by natural or artificial means, because they are reasonably free from the danger of destruction from insect or other pests, and returns from them can be calculated with considerable accuracy.

Chestnut and Red Oak are slower growers and produce a softer and less durable wood than Black Locust, but under ordinary conditions cross-ties can be secured in thirty-five to forty years. The softness can be overcome by the use of proper tie

plates, and durability can be readily secured by treating the wood with chemical preservatives.

Dissatisfied with the results secured, the Pennsylvania Railroad in 1906 requested the co-operation and assistance of the Forest Service of the United States Department of Agriculture in the examination of its holdings and in outlining a forest policy to be followed in the future.

The report submitted recommended that the planting of Black Locust be discontinued at once. Tentative plans for the improvement and management of the existing properties were outlined and suggestions made regarding the purchase of additional lands in regions where trees suitable for cross-ties could be raised within a reasonable period of time and at a low cost.

The result of the investigation was so favorable that the railroad has employed a professional forester to look after the forest interests of the railroad, and put into force a policy which will provide for the production of a large proportion of the cross-ties required by the railroad twenty to thirty years hence.

This appointment marks the beginning, in this country, of practical forestry by railroads, and it is hoped that other railroads will undertake soon the management of forests for the production of the wood supplies needed by them.

The experimental era of forestry is past, and there is no reason why railroads should expend large sums of money in forest work from which no results can be secured. Technical advice on forest subjects can be readily secured, and if railroads will exercise the same business ability in dealing with forest matters that they do in handling their other affairs, there will be no serious mistakes made like those which have occurred in the past.

R. C. Bryant.

NEW METHOD OF MEASURING VOLUMES OF CONIFERS.

Unquestionably the most important development in mensuration in later years is the substitution of the "form quotient,"—as elaborated (after Schuberg's proposition) by Schiffel—for the form factor. We refer the reader who wishes to familiarize himself with the development of this most useful aid in measuring tree volumes to the articles by Dr. Clark in Vol. I, pp. 6-11, 56-61 of the QUARTERLY, and to the briefs in the same volume p. 154, and in Vol. II, pp. 186, 261-265. See also a brief description of the method in Graves's Mensuration p. 188.

As a result of further investigations Schiffel reports* from the Austrian Experiment Station the important discovery that *"all conifers* (the European fir, spruce, pine, larch) *can be approximately but sufficiently accurately cubed upon the basis of one and the same form quotient table."*

Larch is characterized by rapid taper, fir by cylindrical form, spruce by standing between larch and fir, pine by having the upper half of the bole cylindrical. Nevertheless practically the form of boles shows similar relations, and the most important factors which influence form, site and density, react similarly in all.

Hitherto two methods of volume and value determination of stands have been practiced, namely the one based on direct felling of sample trees, a circumstantial and expensive method, or the one based on volume tables *i. e.* tables constructed from series of previous measurements of sample trees. The applicability of such volume tables, based on diameter b. h., height and form factor, if they exist at all (with us yet few are in existence), is circumscribed by the great variation of sites and corresponding forms, they are not very reliable, so that even the carefully constructed and classified (according to species, site and age class) German volume tables give results with errors up to 15 per cent. As Prof. Clark has pointed out, in our forests, the result of natural forces without silvicultural care, such great variations in age classes occur that errors must still be greater.

* *Ueber die Kubirung und Sortierung stehender Nadelholzschafte.* Centralblatt für das gesammte Forstwesen, December, 1906, pp. 493-505.

Hence, to design a more accurate and at the same time less expensive method, independent of volume tables, *i. e.* applicable directly in each individual case has been Schiffel's endeavor. His method, moreover, allows also much more readily than the usual volume tables a differentiation into grades or sizes of the log material.

His method is based upon the practical ability of measuring diameters at different heights of the standing tree, say at one-quarter, one-half, three-quarters of its height ($d\frac{1}{4}$, $d\frac{1}{2}$, $d\frac{3}{4}$), and upon the theoretical consideration that these diameters have a constant relation to the breast-high diameter (D), this relation expressing more or less closely the form. If all four diameters are used, this relation, the form quotient $\left.\frac{d}{D}\right) = q$, describes, of course, the form more closely, but it has been found that the relation of the median diameter $d\frac{1}{2}$, which for the sake of simplicity we will designate with d, diminished by a corrective coefficient or constant c, determined for each species, furnishes sufficiently accurate results, so that the volume, $V = \left.\frac{D^2}{4}\right)\pi \quad h \times (q—c)$; the expression q—c, therefore, is equal to f (form factor). The corrective c has been found for Scotch Pine as .2, for Norway Spruce .21, for our Balsam (by Clark), and for several other conifers not far from .21, and now Schiffel has constructed formulas and tables applicable for all conifers.

The practical difficulty of measuring the median diameter is according to Schiffel satisfactorily overcome by modern dendrometers. (See footnote.) But in order to obviate the necessity of measuring the diameter in each case he develops a method and tables which require merely a classification of stands into form classes according to site, species, crown length, height and diameter, when by finding in the classification table the corrsponding form quotient, the volume data can be read from the form quotient table.

After pointing out, that form and volume are closely related;

* See Centralblatt, etc., 1898; see also description of Burton's "Biltmore Pachymeter" in vol. IV, p. 8 of the QUARTERLY.

that accurate formulas for measuring of natural forms are impracticable, hence that we must form groups and find characteristic relations of dimensions; that the more comprehensive the groups the less accurate the results; the author develops his formula which is to substitute the form quotient (q) for the form factor (f), namely,

$$f = a + bq^2 + \frac{c}{qh};$$

a, b, c being coefficients which differ with different species; but a practical average value of these coefficients for all conifers over 20 feet in height has been established by numerous investigations which permit the definite change of the formula into

$$f = .14 + .66q^2 + \frac{.32}{qh} \quad (1);$$

and from this, when a and $a\frac{1}{2}$ are the areas corresponding to the diameters D and d, at breast high and median—

$$V = h\left(.14\,a + .66a\tfrac{1}{2} + a\frac{.32}{qh}\right) \quad (2)$$

The last member of this formula can be neglected with low heights; with heights over 60 feet its value lies bteween .032 and .01; assuming the average of .02, the formulas change into the approximate formulas

$$f = .16 + .66q^2 \quad (3),$$

$$\text{and } V = h\,(.16a + .66a\tfrac{1}{2}). \quad (4)$$

In words, the volume of a run of coniferous trees is a function of average height and the areas at breasthigh and at half the height.

A table shows comparisons of results according to this formula and according to actual sectioning. The largest error in *single* stems with the approximation formulas was 10%. In *regular stands on any site, no matter how grown, the average error in using equation (2) if at least three sample trees are used, will not exceed 4%.*

The measurement of the median diameter, therefore, produces a considerable increase in accuracy of volume determination above the usual volume table method.

For practical objects of differentiating log classes, the author has developed the relation of the form quotient at one-quarter and three-quarter of the height (q_1 and q_3) to the form quotient at one-half the height (q) namely,

$$q_1 = .46 + .46q^2 + \frac{.40}{qh}\Big) \quad (5)$$

$$q_3 = .14 + .66q^2 - \frac{.20}{qh}\Big) \quad (6)$$

and, since $d^1_4 = Dq_1$; $d^3_4 = Dq_3$, the two diameters are readily calculated.

Applying for the last correcting members of the two equations the experimentally determined averages, we secure the approximation formulas for use with trees over 60 feet in height:

$$q_1 = .485 + .46q^2 \quad (7)$$
$$q_3 = .13 + .66q^2 \quad (8)$$

The degree of error in these formulas moves within the same limits for single trees as stated for the above formulas 1 to 4.

The comparative table, demonstrates the general applicability of the formulas, and brings proof that in spite of the many forms which species, site and density produce, it is possible with sufficient accuracy to determine in all cases form and volume by measuring two diameters and height.

No need of pointing out that form quotients and form factors do not correspond; with increasing height the form factors decrease while the form-quotient remains the same. But the form quotients determined from the relation of diameters at three-quarter and one-quarter height, or at half and one-quarter, or at three-quarter and half height, remain approximately alike, so that for conifers probably quite generally these form quotients are form factors independent of the heights.

A form quotient table based upon the foregoing formulas (see sample on p. 36), giving for different heights under the median form quotient the corresponding form quotient at one-quarter and three-quarter heights, the form factor and a calculated breast high diameter, permits reading off the necessary data

for calculating the volume, if the median diameter has been measured.

If this, according to the author, easy measurement is to be avoided, and only one diameter (D) and h are to be measured, it is possible to find an expression for q as a function of h and D (which is, however, only very roughly approximate and applicable only for large averages) by the consideration that, as is well known, on a large average of all sites and densities with equal heights and decreasing diameter the form factor diminishes.

Such a relation between height, diameter and form quotient was found in the following formula when D is expressed in centimeters:

$$q = .385 + .345 \frac{h-1}{D} + .0326 \left(\frac{h-1}{D}\right) \quad (9)$$

from which follows—

$$D = \frac{h-1}{\sqrt{36.7q + 16.27 - 5.3}} \quad (10).$$

It is this average D thus calculated which figures in the form-quotient table. It would, therefore, be possible to use this table with measurement of height and one diameter, but this the author does not feel warranted in recommending, except for rough approximations of the form-quotient. This diameter is, however, to assist in classifying trees into form classes. To arrive at this classification it is taken into consideration that form is in general a function of density and site, which influences height, and the character of the crown, length, density and form also aid in the classification.

Between the tree of the open with long, dense, regular crown and the slender, small-crowned whip in the dense stand as extremes, the variations range themselves. The author recognizes, without reference to species, five form classes: I, very tapering; II, tapering; III, medium; IV, plump (Vollholzig); V, very plump. A form-class table (see sample on p. 36) then permits the determination of the form quotient of the class, and with this the use of the form quotient table without having measured the median diameter.

In estimating the form class, the habit of the species, height, diameter, site class and crown development must be considered. The following hints for classification are given by the author:

For larch and pine, classes I to IV are usually sufficient and the average quotient for larch may be found as .65, for pine .66, while spruce is rarely found in class I, except when grown in the open, its average form quotient being .68, for fir, the plumpest, .70. Trees grown in close cover fall usually within the three middle classes. All stouter trees have a lower, all slender trees a higher form quotient, the dominant trees being the most tapering. Small crowns, except in entirely suppressed, or diseased trees are a sign of plumpness (cylindrical). The length of the crown, however, differs according to species (lightneeding and tolerant) and hence the species must be considered in applying this criterion. So does the site and height influence form differently with different species. With the same species, same height and same site, the poorer site (slower height growth) has the plumper boles. On good sites, the codominant and laggards are the less tapering.

In estimating, the procedure which the author proposes is first by judgment according to species, site and density to estimate the form class of the stand as a whole. Then, on the basis of height, crown character and diameter of the average tree, estimate its form quotient within this form-class, which would be applicable to the stand; then estimate what form quotients correspond to the several diameter classes, keeping in mind that in normal stands the difference between the lowest and highest diameter class will not exceed .10, so that if the average tree had been estimated to have a form quotient of .66, the lowest form-class might be estimated at .70, the stoutest at .62.

This "form-class method" the author considers an improvement on the usual volume table method because it takes into consideration the individual character of the stand and in addition permits the differentiation into log sizes by means of the calculated diameters at quarter and three-quarter height.

We can afford here only to call attention to this important advance in mensuration and to give a sample of the two tables, which are naturally in the metric system, in order to show their arrangement.

It certainly would be worth while for those in this country who have to measure stands to investigate more closely the applicability of the method and of the figures furnished by Schiffel, and develop its practical application.

B. E. Fernow.

[See Tables on following page.]

FORM CLASS TABLE.

q x 100:	54	58	62	66	70	76	80	
Form Class:	I		II		III		IV	V
Height m	Diameters b h. centimeter							
10	21	17	14	12	11	9	8	8.3
16	35	28	23	20	18	15	14	
20	44	35	30	25	22	19	17	
24	53	43	36	31	27	23	21	
30	67	54	45	39	34	29	27	
36	81	65	54	47	41	35	32	
40	90	72	61	52	46	39	36	

FORM QUOTIENT AND FORM FACTOR TABLE.

Height m	q=.66				q=.68				q=.70				q=.80			
	q_1	q_3	f	D	q_1	q_3	f	D	q_1	q_3	f	D	q_1	q_3	f	D
				cm				*cm*				*cm*				*cm*
10	861	397	476	12.1	872	415	492	11.3	882	435	509	10.7	944	537	602	8.3
15	840	407	459	18.8	852	426	476	17.6	863	444	493	16.6	927	545	589	12.9
20	830	412	451	25.5	842	430	469	23.9	854	449	486	22.5	914	550	582	22.1
25	824	415	446	32.3	837	433	464	30.2	848	452	481	28.4	919	552	578	17.5
30	820	417	443	39	833	436	461	36.5	844	454	478	34.3	911	554	575	26.6
35	817	418	441	35.7	830	437	458	42.8	841	455	466	40.2	908	555	573	31.2
40	815	418	439	52.4	828	438	457	49	839	456	474	46.2	906	556	572	35.8

TABLE FOR DETERMINING THE FINANCIAL INCREMENT PER CENT. OF TREES BASED ON THEIR MARKET VALUES.

This table was worked out by Erling Overland, Forest Estimator in the Norwegian Government service, with whose permission it is here republished.

The object of the table is to find the rate of interest which the growth of standing trees is earning, based on the market value of their contents. The table, in the form in which it is printed, is of universal application.

The price increment per cent. can be obtained from it for any species, or any variation in market values, provided the growth is measured in the English or Norwegian inch. The latter, on which the table is based, is about .03 larger than the English unit,—a difference not large enough to affect the validity of the table.

Before the table can be applied, the necessary data must be obtained, namely, the contents of trees of each inch class which may be taken from a volume table and the net values for each inch class. This value may be obtained either directly by employing market values of stumpage or, if preferred, from a calculation of the value of the marketed product minus the cost of the marketing.

The proportion existing between the values for trees of each inch class and that of the next lower is then found by dividing the former by the latter. This proportion gives the basis for the application of the table. In column F are given proportions from 1.1 to 4.0. If trees of 15-inch diameter are worth 1.6 times as much as trees of 14-inch diameter, their rate of price increment per cent. will be found opposite the figure 1.6 in column F, and it will, of course, depend on the rapidity of growth, as shown by the number of rings in the last one-half inch of the radius: the greater the number of these, the lower the rate. If for instance 12 rings are found on the last one-half inch of the radius, which would be equivalent to 1 inch in diameter in 12 years, the per cent. will be found to be 4, for the given prices.

Having obtained the needed proportions by dividing the value of each inch class by that of the next smaller, the diameter classes

represented by each proportion obtained, are entered in the blank column headed "Dimensions," and the table is complete.

For example, the contents in board feet and the net values may be based on a stumpage value of $10.00 per M board feet.

8	trees	contain	30	board	feet.	Net	value	$0 30
9	"	"	47	"	"	"	"	47
10	"	"	65	"	"	"	"	65
11	"	"	90	"	"	"	"	88
12	"	"	110	"	"	"	"	1 10
13	"	"	140	"	"	"	"	1 40
14	"	"	180	"	"	"	"	1 80
15	"	"	220	"	"	"	"	2 20

Then F, or the proportion between the inch classes is found:

Net value of	15″	tree:	Net value of	14″	tree or	2.20:	1.80=1.2
"	"	"	14″	"	"	"	"	13″	"	"	1.80:	1.40=1.3
"	"	"	13″	"	"	"	"	12″	"	"	1.40:	1.10=1.3
"	"	"	12″	"	"	"	"	11″	"	"	1.10:	.88=1.3.
"	"	"	11″	"	"	"	"	10″	"	"	.88:	.65=1.4
"	"	"	10″	"	"	"	"	9″	"	"	.65:	.47=1.4
"	"	"	9″	"	"	"	"	8″	"	"	.47:	.30=1.6

Fill in under Dimensions:

14″ to 15″,	opposite 1.2
11″ to 12″, 12″ to 13″, 13″ to 14″,	" 1.3
9″ to 10″, 10″ to 11″,	" 1.4
8″ to 9″,	" 1.6

and so forth.

Next find the number of years required to grow ½ inch in radius (1 inch in diameter) for each diameter class. This is most easily done by means of an increment borer, but a knife or axe may sometimes do.

When 4 per cent. interest is desired, it can be at once seen how rapidly the trees of each class must be growing in order to earn this rate of interest on the investment, and whether it is more profitable to cut or leave them. In other words, we can determine the financial ripeness of the stand.

If 4 per cent. interest is desired and the above example is used, then:

8″	trees	should	be	cut	when	they	require	12	years	to	grow to 9″
9″	"	"	"	"	"	"	9	"	"	"	10″
10″	"	"	"	"	"	"	9	"	"	"	11″
11″	"	"	"	"	"	"	7	"	"	"	12″
12″	"	"	"	"	"	"	7	"	"	"	13″
13″	"	"	"	"	"	"	7	"	"	"	14″
14″	"	"	"	"	"	"	5	"	"	"	15″

smaller diameters will be found to grow more slowly than the

In even-aged stands which are to be practically clear cut, the larger. At the same time, the larger trees, to earn the same rate of interest, must grow more rapidly than the smaller. So it will probably be found by the application of such a table, that the per cent. of increase in value for the whole stand can be determined from a very few measurements.

The table is of equal value in uneven-aged stands, as in even-aged, since the rate of increase of each diameter class is determined separately. In fact there are probably few conditions in America to which it cannot be successfully applied as a guide to determine the advisability of holding standing timber and as a rough indication of the most profitable rotation.

NILS B. ECKBO.

FINANCIAL INCREMENT TABLE

BY ERLING OVERLAND

DIMENSIONS	F	Number of Annual Rings on the Last Half Inch of the Radius.																														F
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
	1.1	4.9	3.2	2.4	1.9	1.6	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3		1.1
	1.2	9.5	6.3	4.7	3.7	3.1	2.6	2.3	2.0	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.6	0.6		1.2
	1.3	14.0	9.1	6.8	5.4	4.5	3.8	3.3	3.0	2.7	2.4	2.2	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.1	1.1	1.1	1.0	1.0	0.9	0.9		1.3
	1.4	18.3	11.9	8.8	7.0	5.8	4.9	4.3	3.8	3.4	3.1	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.5	1.4	1.4	1.3	1.3	1.3	1.2	1.1		1.4
	1.5	22.5	14.5	10.7	8.4	7.0	6.0	5.2	4.6	4.1	3.8	3.4	3.2	2.9	2.7	2.6	2.4	2.3	2.2	2.0	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.5	1.4	1.4		1.5
	1.6	26.5	17.0	12.5	9.9	8.1	6.9	6.1	5.4	4.8	4.4	4.0	3.7	3.4	3.2	3.0	2.8	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.8	1.7	1.6	1.6		1.6
	1.7	30.4	19.4	14.2	11.2	9.2	7.9	6.9	6.1	5.5	4.9	4.5	4.2	3.9	3.6	3.4	3.2	3.0	2.8	2.7	2.6	2.4	2.3	2.2	2.1	2.1	2.0	1.9	1.8	1.8		1.7
	1.8	34.2	21.6	15.8	12.5	10.3	8.8	7.6	6.7	6.1	5.5	5.0	4.6	4.3	4.0	3.7	3.5	3.3	3.1	3.0	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	2.0		1.8
	1.9	37.8	23.9	17.4	13.7	11.3	9.6	8.4	7.4	6.6	6.0	5.5	5.1	4.7	4.4	4.1	3.8	3.6	3.4	3.3	3.1	3.0	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.2		1.9
	2.0	41.4	26.0	18.9	14.9	12.2	10.4	9.1	8.0	7.2	6.5	6.0	5.5	5.1	4.7	4.4	4.2	3.9	3.7	3.5	3.4	3.2	3.1	2.8	2.8	2.7	2.6	2.5	2.4	2.3		2.0
	2.1	44.9	28.1	20.4	16.0	13.2	11.2	9.7	8.6	7.7	7.0	6.4	5.9	5.4	5.1	4.7	4.5	4.2	4.0	3.8	3.6	3.4	3.3	3.1	3.0	2.9	2.8	2.7	2.6	2.5		2.1
	2.2	48.3	30.1	21.8	17.1	14.0	11.9	10.4	9.2	8.2	7.4	6.8	6.3	5.8	5.4	5.1	4.7	4.5	4.2	4.0	3.8	3.6	3.5	3.3	3.2	3.1	3.0	2.9	2.8	2.7		2.2
	2.3	51.7	32.0	23.1	18.1	14.9	12.6	11.0	9.7	8.7	7.9	7.2	6.6	6.1	5.7	5.3	5.0	4.7	4.5	4.3	4.0	3.9	3.7	3.5	3.4	3.3	3.1	3.0	2.9	2.8		2.3
	2.4	54.9	33.9	24.5	19.1	15.7	13.3	11.6	10.2	9.2	8.3	7.6	7.0	6.5	6.0	5.6	5.3	5.0	4.7	4.5	4.3	4.1	3.9	3.7	3.6	3.4	3.3	3.2	3.1	3.0		2.4
	2.5	58.1	35.7	25.5	20.1	16.5	14.0	12.1	10.7	9.6	8.7	7.9	7.3	6.8	6.3	5.9	5.5	5.2	4.9	4.7	4.5	4.3	4.1	3.9	3.7	3.6	3.5	3.3	3.2	3.1		2.5
	2.6	61.2	37.5	27.0	21.1	17.3	14.6	12.7	11.2	10.0	9.1	8.3	7.6	7.1	6.6	6.1	5.8	5.5	5.2	4.9	4.7	4.4	4.2	4.1	3.9	3.7	3.6	3.5	3.4	3.2		2.6
	2.7	64.3	39.2	28.2	22.0	18.0	15.2	13.2	11.7	10.4	9.4	8.6	7.9	7.4	6.8	6.4	6.0	5.7	5.4	5.1	4.8	4.6	4.4	4.2	4.1	3.9	3.7	3.6	3.5	3.4		2.7
	2.8	67.3	40.9	29.4	22.9	18.7	15.8	13.7	12.1	10.8	9.8	9.0	8.2	7.6	7.1	6.6	6.2	5.9	5.6	5.3	5.0	4.8	4.6	4.4	4.2	4.0	3.9	3.7	3.6	3.5		2.8
	2.9	70.3	42.6	30.6	23.7	19.4	16.4	14.2	12.6	11.2	10.2	9.3	8.5	7.9	7.4	6.9	6.5	6.1	5.8	5.5	5.2	5.0	4.7	4.5	4.4	4.2	4.0	3.9	3.7	3.6		2.9
	3.0	73.2	44.2	31.6	24.6	20.1	17.0	14.7	13.0	11.6	10.5	9.6	8.8	8.2	7.6	7.1	6.7	6.3	6.0	5.6	5.4	5.1	4.9	4.7	4.5	4.3	4.2	4.0	3.9	3.7		3.0
	3.1	76.1	45.8	32.7	25.4	20.8	17.5	15.2	13.4	12.0	10.8	9.9	9.1	8.4	7.8	7.3	6.9	6.5	6.1	5.8	5.5	5.3	5.0	4.8	4.6	4.4	4.3	4.1	4.0	3.8		3.1
	3.2	78.9	47.4	33.7	26.2	21.4	18.1	15.6	13.8	12.3	11.2	10.2	9.4	8.7	8.1	7.5	7.1	6.7	6.3	6.0	5.7	5.4	5.2	5.0	4.8	4.6	4.4	4.2	4.1	4.0		3.2
	3.3	81.7	48.9	34.5	27.0	22.0	18.6	16.1	14.2	12.7	11.5	10.5	9.6	8.9	8.3	7.7	7.3	6.9	6.5	6.2	5.8	5.6	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.1		3.3
	3.4	84.4	50.4	35.8	27.7	22.6	19.1	16.5	14.6	13.0	11.8	10.7	9.9	9.1	8.5	8.0	7.5	7.0	6.7	6.3	6.0	5.7	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.2		3.4
	3.5	87.1	51.8	36.8	28.5	23.2	19.6	17.0	14.9	13.3	12.1	11.0	10.1	9.4	8.7	8.1	7.6	7.2	6.8	6.5	6.1	5.9	5.6	5.4	5.1	4.9	4.7	4.6	4.4	4.3		3.5
	3.6	89.7	53.3	37.7	29.2	23.8	20.1	17.4	15.3	13.7	12.3	11.3	10.4	9.6	8.9	8.3	7.8	7.4	7.0	6.6	6.3	6.0	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4		3.6
	3.7	92.4	54.7	38.7	29.9	24.4	20.6	17.8	15.6	14.0	12.6	11.5	10.6	9.8	9.1	8.5	8.0	7.5	7.1	6.8	6.4	6.1	5.9	5.6	5.4	5.2	5.0	4.8	4.6	4.5		3.7
	3.8	94.9	56.1	39.6	30.6	24.9	21.0	18.2	16.0	14.3	12.9	11.8	10.8	10.0	9.3	8.7	8.2	7.7	7.3	6.9	6.6	6.3	6.0	5.7	5.5	5.3	5.1	4.9	4.7	4.6		3.8
	3.9	97.5	57.4	40.5	31.3	25.5	21.5	18.5	16.3	14.6	13.2	12.0	11.0	10.2	9.5	8.9	8.3	7.9	7.4	7.0	6.7	6.4	6.1	5.8	5.6	5.4	5.2	5.0	4.8	4.6		3.9
	4.0	100.0	58.7	41.4	32.0	26.0	21.9	18.9	16.7	14.9	13.4	12.2	11.3	10.4	9.7	9.1	8.5	8.0	7.6	7.2	6.8	6.5	6.2	5.9	5.7	5.5	5.3	5.1	4.9	4.7		4.0

F=Proportion between net value of one inch class and the next lower.

Copies of above table may be had at 10 cents a copy from Business Manager FORESTRY QUARTERLY.

NOTES ON BALSAM FIR.

The following study was made in the north central part of Maine on Frenchtown, an unorganized township lying on the Moosehead Lake watershed. It is roughly 7 miles east of the Lake on a direct line from Lily Bay, which is 12 miles north of Greenville Junction, the terminus of a branch line of the Bangor and Aroostook Railroad. Attention was confined to the determination of a single main point, namely, to what extent the fir is replacing the spruce on different types after different methods of cutting, with the view of ascertainng the best practical methods of handling the land so as to maintain the proportion of spruce wherever possible, and to get the best results from the fir. To properly determine this point it was necessary to make as careful observations as possible on the tolerance of the fir, power of recovery after suppression, its resistance to windfall, its soundness at different ages and under different conditions, and its rapidity of growth as compared with the spruce.

Tolerance. Notes taken under various conditions of situation and growth tend to show that in this region fir is less tolerant than spruce. The facts pointing to this conclusion are:

1.—In dense stands there is less young fir than spruce, and in such stands spruce continually shows better thrift than fir.

2.—In close stands fir prunes itself better than spruce.

Several instances were found of increased growth in height and diameter after a period of 80 to 88 years' suppression but it is doubtful if these trees would grow to a merchantable size.

The age limit after which good recovery is obtained after suppression, was indicated to be approximately 50 to 60 years.

Windfall. In situations which are even slightly exposed in this locality, fir is particularly subject to windfall after it reaches a diameter breast high of 15 inches. Unlike the windthrown spruce which is nearly always uprooted, the fir with few exceptions is broken off at a height of from 5 to 10 feet from the ground. If the tree is attacked by fungus rot, as many of them are, by the time it reaches a diameter of 15 to 18 inches the heart-wood is so weakened above the butt that it is easily thrown by wind.

Windfall is most prevalent on the slopes having a northwesterly aspect.

Results of Observations of 301 Wind-thrown Fir.

Type	No. of observations	Broken above butt	Av. hgt of stump feet	Uprooted	Average D. B. H. in.	Percent broken above butt
Flat, ...	82	80	5	2	15	97
Lower slope, ..	193	182	7	11	16	94
Upper slope, ..	37	30	6	7	14	81

Soundness. The soundness of fir timber depends chiefly on the percentage of fir in the stand. It must also vary somewhat with the situation on which the tree is found and with the soil and moisture conditions under which it is growing. How far these latter influences affect the tree it was impossible to determine, except to note that the age limit of sound trees is greater on the higher elevations. That is, on the flats the fir dies out of the stand at a comparatively young age, approximately 50-60 years, whereas on the slopes and upper slopes it is found perfectly sound at 72 years, and even at 118 years it is only very slightly injured by rot at the centre. This applies to fir in a mixed stand. In a pure stand of even-aged fir, caused by windfall (or other accident), the trees begin to be attacked by rot as soon as they are 8 inches in diameter and between 50 and 60 years old. But the stand may safely be allowed to grow for 10 to 20 years longer till the trees reach a diameter of between 13-14 inches and an age of approximately 70 years. If they are left any longer than this the trees will be broken off by the wind, as described in the paragraph above on windfall. The yield of such a stand, of pure fir 60-70 years old, on lower slope, taking everything down to 11 inches inclusive as merchantable, and proportion of unsoundness was found to be:

Yield Per Acre of Pure Fir Stand.

Unit of measure	Total volume per acre.	Volume of Sound	Volume of Unsound	Per cent of Unsound
Cubic feet, ...	617.5	450.8	166.7	27
Board feet, ...	3,705	2,704.7	1,000.3	27

The best silvicultural method of treating land of this kind would be to cut the fir down to a diameter limit of 10 inches or possibly lower, exercising care to leave the spruce to seed up the area. If a ten-inch diameter limit is used, there is a fair chance

of a second cut after 25 years. This will accomplish two results:

First, the stand will eventually contain a very fair proportion of spruce; and, secondly, the fir which will then be left will occur in mixture, and hence will no longer be so subject to rot, and therefore much more valuable.

Growth. Although it was impossible in the limited time to obtain the large amount of data which would be required for an exhaustive study of growth, yet enough measurements were taken to show the relative growth in height and diameter for comparisons needed in this study.

For the purpose of the study it is necessary to divide the trees into two classes:

1st. Those which have been suppressed in early life and attained their normal growth after the removal of the cause of suppression either by cutting, windfall or natural death. These are the trees which have grown up under natural conditions, and, with the exception of the pure stands on the areas of old windfall, they form the greater part of the mature fir.

2nd. Those which have never been suppressed. These represent the increase in the proportion of fir after cutting or windfall. That is, they are those trees which were not in the original under-story, but were seeded in after the opening was made. In view of the increase of the fir after cutting, this class will assume more importance in the future. On account of the comparatively recent cutting in this stand, it was impossible to get many measurements on mature trees to show the growth of this class. But such figures as were obtained are suggestive.

The mean annual, minumum annual and maximum annual growth of the first class of trees during and after suppression is shown in the following table:

Increase in Growth After Suppression.

(Lower Slope—Spruce and Hardwood Type. Based on 43 Trees.)

Period	Mean annual growth, inches	Min. annual growth, inches	Max. annual growth, inches
During suppression, ...	.044	.014	.056
After suppression, ...	.158	.044	.286

This shows the enormous stimulus which the growth receives after suppression is removed, the rate being more than three times as great as it was during suppression.

Under the best conditions of growth rings were found .31 of an inch wide for a single year. A maximum growth in height was 1.6 feet for a year; while a fair average of height growth under good conditions is 1.1 feet per year.

The following table shows the rate of growth for the last two decades.

Rate of Growth for Last Two Decades.

(Based on 51 Trees.)

Age Class	Mean Annual Growth		Time required to grow one inch		Thickness of bark
	Last decade	Decade before last	Last decade	Decade before last	
	Inches		Years		Inches
Sapling up to 3 in. D. B. H., ...	.056	.036	18.1	28.6	.08
Mature up to 13 in. D. B. H., ...	.18	.138	5.5	7.4	.27
Overmature — over 13 in. D. B. H.,	.150	.19	6.6	5.3	.33

In a stand of pure fir yielding between 3000 and 4000 feet B. M. per acre, a mean sample tree of this first class which had been suppressed for 46 years before attaining its normal growth was taken. It contained 31 cubic feet or 186 board feet merchantable timber, taken down to 6 inches. It was 98 years old, 13.6 inches breast high and 68.6 feet high. Its average growth during suppression was .038 of an inch, which increased to .252 after suppression.

The following table from the analysis of this tree will show what the fir can do under ordinary conditions:

Rate of Growth in Height and Diameter of 98-Year-Old Fir.

(Suppressed 46 Years.)

Age Years	Height feet	Diam. stump in.	Diam. 16 ft. above stump in.	Diam. 32 ft. above stump in.	Diam. 48 ft. above stump in.
10	3.5	.41			
20	7.	.95			
30	10.6	1.4			
40	14.7	1.9			
50	19.4	2.4			
60	25.3	4.2	1.2		
70	32.5	7.	3.1	1.5	
80	41.6	9.5	5.1	3.7	
90	55.	12.6	8.	6.	2.1
100	70.	15.2	11.	8.9	5.1

From such figures as could be obtained for mature trees which had never been suppressed, averaging 54 years old, the mean

annual growth was found to be .225 of an inch, and the number of years required for trees of this class to grow 1 inch was 4.4.

The following table will show the difference between the rate of growth of fir and spruce, the figures on spruce being taken from R. T. Hosmer's "A Study of Maine Spruce," in the Report of the Forest Commissioner of Maine for 1902:
time as great as it was during suppression.

Comparative Rate of Growth of Spruce and Fir.

Species	Mean annual growth inches	No. of years to grow one inch
Spruce, ...	.126	8.
Fir, natural condition, ...	.180	5.5
Fir, unsuppressed, ...	.225	4.4

Reproduction on Forest Types after Lumbering and Windfall.

Flat type. A certain part of this type is virgin stand except for a culling here and there of the best timber made 30 years ago, when methods of lumbering were more crude and no tree with the slightest defect could be taken. Hence the present conditions are practically those which have been obtained under the influence of natural agencies without the interference of man. This stand may be divided into two sub-types according to the composition. First there is the *nearly pure spruce,* containing approximately 85 per cent. spruce, 10 per cent. hardwoods and 5 per cent. fir, and secondly the *spruce* and *hardwoods*, containing 55 per cent. spruce, 40 per cent. hardwoods and 5 per cent. fir.

Although in each case in the mature stand the fir is greatly outnumbered, yet in the understory it makes a much more prominent showing. In the pure spruce stand it forms 35 per cent. of the coniferous reproduction, with 65 per cent. for the spruce; whereas in the spruce and hardwood stand the young fir actually surpasses to a slight extent the young spruce. Still in spite of the apparent abundance of the fir in the young growth in this type, its scarcity in the mature stand and the high percentage of rot, tends to demonstrate that in the long run, *under natural conditons*, it is unable to compete successfully with the spruce, and, however abundant it may be in the understory, it will never amount to much in the old stand. When, however, the large spruce is cut, as it necessarily must be, the fir is given an increased chance at the expense of the spruce.

The following tabular form illustrates the contrast between the mature stand and understory.

Proportion of Spruce and Fir in Mature Stand and in Understory.

Type	Mature Stand Spruce	Mature Stand Hard-woods	Mature Stand Fir	Understory Spruce	Understory Fir
	Per cent.			Per cent.	
Pure Spruce, ...	85	12	3	65	35
Spruce and Hardwood, ...	53	43	4	46	54

In studying the effect of windfall on the flat type, enough examples were seen to establish the fact that wherever areas of spruce have been blown down, nearly pure stands of fir follow.

Spruce flats, subjected to windfall 61 years ago, show an average composition indicated by sample plots as follows:

Composition of Stand following Windfall.
(Flat Type.)

	Taken to 8 in. D. B. H. incl. Per cent.	Taken to 2 in. D. B. H. incl. Per cent.
Fir	84	57
Spruce	8	23
Cedar	2	6
Yellow Birch	2	5
Maple	3	5
White Birch		3
Beech	1	1
Total	100	100

The decrease in percentage of fir when trees under 8 inches are taken, shows how the fir will eventually be replaced.

Slope Type. The greater proportion of slopes are covered with a mixed stand of hardwoods (yellow birch, white birch, beech and maple), with spruce and fir in varying proportions, and with white cedar in the swales.

On a spruce and hardwood slope a virgin stand which was beginning to open up of itself because of over-maturity, had an approximate composition, considering trees over 12 inches, of 56% spruce, 22% fir and 22% hardwoods. Wherever the stand was opened up by wind-thrown, or by the dying out of old trees, hardwoods comprised the bulk of the young growth, while spruce lead the fir in a proportion of 5 to 4. The young fir, however, did not show the same thrift as the spruce, and under a continuance of the conditions which have heretofore prevailed, the spruce would probably maintain its predominance over the fir.

In the case of a pure or nearly pure spruce stand, there is always the danger of windfall on exposed situations. In the event of such a windfall where the mature spruce has a large proportion of fir in the understory, a dense stand of nearly pure fir follows. A pure spruce stand which was blown down 56 years ago had the following composition to-day.

Composition of Stand following Windfall.

(Slope Type.)

	Down to 8 in. D. B. H. incl. Per cent.	Down to 2 in. D. B. H. incl. Per cent.
Fir	87	52
Spruce		21
Maple	7	11
Yellow Birch	6	9
White Birch		3
Cedar		3
Beech		1
Total	100	100

If there is a stand predominantly spruce, that is about 70 per cent. spruce, with a fair proportion of hardwoods in mixture, and windfall occurs as a result of cutting part of the spruce on exposed situations, the future stand will be composed principally of hardwoods and fir. The hardwoods to a great extent survive the windfall and hence are left to seed up the area, while the fir which is already present in the understory in abundance comes in still more abundantly in the opening, and hence leads the spruce in the new stand. The resulting composition on such an area was found to be 40% hardwoods, 32% fir and 28% spruce. Where clear cutting of the spruce is resorted to on account of the danger of windfall the same consequences will follow. Hence on a tract of this kind it is advisable either to cut much more lightly than elsewhere, or to cut in strips so chosen that the timber left will be protected from windfall.

Where hardwoods and conifers are present in about equal proportion, the amount of hardwoods and fir which will come in after lumbering increases with the heaviness of the cutting. On a small area which had been carelessly slashed over 26 years ago, the composition was found to be roughly 70% hardwoods, 25% fir, and only 5% spruce. Even the most careful cutting cannot help diminishing, to a certain extent, the proportion of spruce and increasing the hardwoods and fir. Nevertheless very fair results

have been obtained by the method of cutting to a 12 inch breast high diameter limit, at present employed by the company operating on this township. The composition on an area cut over in this manner was found to be:

Stand of Cut to 12 Inches D. B. H.

Species	Old Stand (Left after cutting)	Understory
Spruce	26%	26%
Fir	10%	21%
Hardwoods	64%	53%

This shows that the spruce in the young growth is exactly equal to the spruce left in the old stand after thinning, while the fir has increased more than double. Hence the spruce, in this case, has been diminished by precisely the amount which was cut, although this amount will vary, with different situations. The figures make it appear as if the proportion of hardwoods had decreased from 64 per cent. to 53 per cent. But it must be considered that the spruce has been cut and hardwoods left so that the original proportion of hardwoods before cutting could not have been roughly over 40 per cent. of the total stand. Hence in reality the hardwoods have increased from approximately 40 per cent. in the original uncut stand to 53 per cent of the new growth. There is no doubt under the prevailing conditions that this method is the best practical one for retaining the spruce which can be devised. Although to prevent the great increase of fir, if that species continues to be of as little value to the company as at present, it should be entirely cut out, even if not utilized, wherever logging operations are carried on.

Spruce Slope Type. This type is found on the mountain sides at higher elevations than the spruce and mixed hardwood slope. The composition is practically pure spruce growing where the soil is extremely shallow, or in a large part of the type almost entirely lacking, the roots of the trees and a layer of moss forming the only covering of the large loose boulders.

In a mature stand the trees range from 2 to 15 inches in diameter, growing very close together. The understory is also of pure spruce with only about 2 per cent. of fir. When such an area is clear cut, as it is generally necessary to do on account of exposure to windfall, the fir and hardwoods come in but are still

well behind the spruce in percentage of the whole stand. The resulting composition of the young growth found on such a type cut over 8 years ago was 60 per cent. spruce, 22 per cent. hardwood and only 18 per cent. fir.

When the growth on the spruce slope has become somewhat over-mature and is beginning to open out of itself, we find the fir still composing only about 2 per cent. of the old trees, but forming approximately 50 per cent. of the understory. The explanation of this state of affairs is found in the respective requirements of the two species. The spruce, on account of its ability to grow with almost no soil, will cover the poorest and rockiest situations where nothing else can subsist. Then as better soil and moisture conditions are developed by the action of weathering and of the roots of the trees, other species will gradually come in.

Cutting an over-mature spruce slope then will bring in more fir than cutting on a younger slope. The spruce, however, will probably continue to be predominant in the natural course of events; because it will take such an area which has been clear cut a long while to contain merchantable timber anyway, and the spruce will always beat the fir out in the long run, on account of its greater longevity.

Reproduction on Burned-Over Land.

In contrast with the cases previously cited, it is interesting to note that on the areas of burned-over land, which were studied, spruce always leads the fir in the young growth.

A tract of flat land lying along the north shore of Roach Pond which was entirely burned over 38 years ago and which, at present, is occupied by a good stand of White Birch, Yellow Birch, Poplar and Cherry was found to contain an excellent understory of young spruce, while the only young fir discovered was limited to a narrow strip along the water edge. This fir in no case reached 25 per cent. of the composition of the understory. Over the burnt area birch and poplar seeded in the year following the fire, the spruce 6 years after, and the fir not until 8 years afterwards.

On a slope, on the other hand, which was burned over 33 years ago, young fir was found in greater abundance than on the flat

occupying approximately 40 per cent. of the understory to the spruce's 60 per cent.

The explanation of the preponderance of the spruce over the fir in the young growth on these burned-over areas, seems to lie in the different soil and moisture requirements of the two species. Whereas the spruce can adapt itself to a soil leached by fire, the fir requires more moisture in the upper layers, and hence is only found seeding in along the water's edge or on well drained slopes.

Summary. A summary of points in regard to the character of fir may be here briefly stated:

1. Fir is less tolerant than Spruce.

2. Fir is especially subject to windfall in this locality, after a diameter of 15 inches breast high is reached.

3. In pure stands fir is subject to rot at the butt after the age of 50 years is reached, particularly in moist situations. In mixture with hardwoods the percentage of rot is smaller and the trees are usually sound up to an average age of 85 years.

In considering the treatment of the forest with relation to fir, the following point may be emphasized:

1. In virgin stands on a flat or lower slope type under the influences of natural agencies (exclusive of accidents due to windfall and fire), fir occupies less than 5 per cent. of the stand. On upper slopes the percentage is considerably higher.

2. After windfall in a pure spruce flat or slope, a pure stand of fir follows. After windfall in a spruce stand containing hardwoods, a stand of predominantly hardwoods and fir results.

3. On a mixed hardwood and spruce slope the proportion of fir is doubled after each cutting. If the cut is too heavy, the fir will surpass the spruce in the next generation.

4. On a pure spruce slope which has to be cut clean on account of danger from windfall, the fir will increase from approximately 2 to 20 per cent.

5. Although the fir is seen to be so abundant in the young growth after cutting, it is probable in many cases that it will eventually die out and its place be taken by the spruce. At the same time it must be considered that while the fir is growing it is not only retarding the spruce but occupying space, and hence causing just so many years' loss of growing time to that species.

Barrington Moore, and
Robert L. Rogers.

NOTE ON TROPICAL WOOD SUPPLIES.*

In the year 1900 the long predicted timber famine made its entrance into the United States, if a sudden rise in prices is the characteristic of dearth. It came on time, exactly as predicted. In that year the price of White Pine lumber, up to that time our principal staple, jumped all at once to almost double its previous value, and all other lumber staples increased in price rapidly, and have crept up ever since. Builders of houses especially, have begun to realize that the time of wood for building material is begining to pass away; other, better materials are becoming relatively cheaper. This, the substitution of other materials, is, of course, the first, best and natural remedy for the rapid increase of timber famine prices. All efforts at introduction of forestry methods and at re-forestation are designed, and can be effective only for the days of a much more distant future.

The opening up of the timber resources of the tropical countries to the south of us has been often pointed out as our ultimate recourse. It becomes, therefore, of interest to learn what we may expect from this quarter, to learn what the character of the woods and the character of the forests in these warm countries is, with a view to the possibility of substituting their product in our lumber market.

Quality, quantity and expense are the three considerations of the market.

We must realize first that our enormous lumber consumption consists to the extent of from 65 to 75 per cent. in soft wood material, only a little over one quarter, outside of fuelwood, comes from hard woods. And the soft woods which are most in demand are those of the conifer tribe, which furnish the best all round materials for the most varied uses, and especially for building and box manufacture, two of the most important uses of wood. Moreover these conifers, pines, spruces, firs, grow gregariously on large areas, hence are most readily and economically logged.

If we examine the woods and the forests of tropical countries, we find that the areas of coniferous wood are exceedingly limited, that the character of these is as a rule inferior to our north-

* Read before the Association for Advancement of Science, Dec., 1907.

ern product, and that woods of the greatest hardness make up the bulk of tropical growth. There are some few exceptions to this rule. Just as we find among our broadleaf trees a few species which produce a soft wood that can be used in substitution of coniferous material, so there are to be found a few tropical species of that description.

Hitherto, from the tropics, only fancy cabinet woods, in which hardness is a virtue, have been able to secure recognition in the markets, and the character and behavior of the soft woods of the tropics is hardly known.

The presumption is, that, just as our soft-wooded broadleaf trees, which form a small proportion of our broadleaf forest, furnish only an inferior substitute for coniferous wood, the tropical soft-wood species will be of the same category; in addition, the climate will introduce difficulties in handling the material in such a manner as to avoid the shrinking and warping, the working of the wood, which is the greatest drawback of all wood material except the coniferous.

As far then as this portion of eventual substitutes is concerned, we can be sure, that it will be of much inferior character to what we have been accustomed.

The next question is that of expense. The long distance to which lumber would have to be freighted not only from seaports but from interior sections, and not only to seaports but to interior sections, will in itself be for a long time an unsurmountable obstacle in the utilization of these sources of supply, but other natural conditions in the character of the forest growth create additional difficulties and expense.

The character of the tropical forest differs very greatly from the northern forest, in that it is composed of a much greater variety of species, growing by no means gregariously as our most important species do, but participating in more or less equal degree in the composition. Hence to secure a quantity of any one class of wood large areas will have to be picked over, as is now done when the expensive cabinet woods, mahogany and cedar, are exploited.

Another factor, increasing the cost of expense in logging, is the fact that the trees of commercial size are as a rule much more

scattered than with us, in other words small quantities per acre of valuable forms and sizes is the rule.

There are, of course, exceptions to these general features.

There are on the plateau lands of Mexico extensive pineries in accessible locations, but compared with our requirements neither in quality nor quantity comparable to our own. Otherwise, tropical conifers are usually confined to inaccessible locations.

There are lowlands, as for instance along the Magdalena River in Columbia, which bear heavy forest growth of commercial character, and contain even large proportions of soft woods that might be exploited profitably. But the general prevailing condition is as we have described. In addition there are climatic and populational conditions, which are by no means to be overlooked in the problem of exploiting and marketing whatever supplies would be really available.

The resident population is in most locations neither sufficient nor efficient, and the climate is not favorable to logging work. Even if the labor necessary to carry on logging and milling enterprises could be eventually attained, efficient superintendence is still more difficult to secure under the undesirable social and climatic conditions. At any rate, cheap logging, which the low wage apparently warrants, will actually not be realized.

We come then to the conclusion, that but little comfort can be expected in dealing with our timber famine, approaching and in progress, by securing supplies from our southern neighbors. While the increase in wood prices will perhaps make the profitable exploitation of favorably located tropical forests possible, neither the character of their woods, nor the quantity they can supply promises to satisfy our needs readily.

B. E. Fernow.

CURRENT LITERATURE.

HENRY S. GRAVES, *in Charge.*

A Brief History of Forestry, in Europe, the United States and other Countries. By Bernhard E. Fernow. New Haven, 1907. Advance Copy.

The study of the development and practice of forestry in foreign countries is very important for every forester. There is a common prejudice against the methods of forestry employed in other countries on the ground that our forest conditions and economic conditions are peculiar and that on this account therefore, foreign methods are not applicable in this country. It is, of course, true that we cannot take European methods, applicable to forests which have been under management many years and apply them without modification to forests of different species, different form, and different silvical character. The practice of forestry tends, however, to bring about more or less artificial forms of stands which ultimately must be handled by methods very similar to those practiced in other countries. Most of the methods which we are practicing today are in reality modifications of methods practiced in Europe and as our silviculture develops we will approach more and more to the systems practiced there, although undoubtedly some methods peculiarly American of silviculture will be developed. It is of great importance, therefore, that the student understands not only the practice of forestry in other countries, but how the present methods have been developed. When one studies the development of forestry abroad one is immediately surprised to find that many methods which are now used in this country were used in Germany and elsewhere many years ago. One finds that in the early days in Germany a rough selection method by diameter limit was used, similar to that employed in Maine, that oak polewoods were treated as we are in many cases handling our southern New England woodlands, and that many of the other methods of silviculture now employed by us have their counterparts in the history of the different countries in Europe. In the same way, many of our methods of mensuration which some have supposed to be original with us were used in Germany when the

forests were irregular and unorganized. The development from these early beginnings to the refined methods of to-day is of great use in aiding the American forester in the development of silvicultural policies and in other work of organization.

For this reason I welcome Dr. Fernow's History of Forestry, which places in the hands of the student an excellent historical outline of the development and practice of forestry in the important foreign countries.

Dr. Fernow devotes a large space in the book to the history of forestry in Germany. This is in part due to the fact that there are much more complete records of the history of forestry in Germany than in other countries, but chiefly because, in the opinion of the author, forestry has there reached a higher plane of development than elsewhere. Dr. Fernow calls attention to the strong German influence which is to be found in the growth of forestry in most countries, including Austria, Hungary, Switzerland, Russia, the Scandinavian States, and India. Even France did not remain uninfluenced by German ideas.

The history of forestry in Germany is divided into three periods, namely, to the end of the middle ages, second, to the end of the 18th century, and third, the modern period. The author describes for each of these periods the political conditions of the country, which have a bearing on forestry, the development of the laws of forest policy, the progress in silviculture, forest organization, mensuration, natural science, experimentation, literature, etc. It is interesting to read of the controversies between the so-called practical men and those well trained in forestry. Apparently every country has to pass through the same contest between those who recognize the scientific character of the basis of forestry and those who regard the practice of forestry as essentially utilization. Foresters will be interested to compare the controversies toward the end of the 18th century in Germany with those of the present time in this country.

The book covers also the history of forestry in Austro-Hungary, Switzerland, France, Russia, Finland, the Scandinavian States, the Mediterranean Peninsulas, and Great Britain and her colonies.

The advance copies of the book in the hands of the reviewer were still incomplete. It is the author's design before final publi-

cation to add an account of the history of forestry in Japan and the United States.

Austro-Hungary is of particular interest to Americans because of the large amount of private land, some of which is in large holdings. A study of the plans of co-operation between the State and the private owners is of peculiar value to us, as we are developing State forest policies in this country. One is naturally interested in Norway, Sweden, Russia, and other countries which export timber and still have extensive virgin forests.

With regard to India Dr. Fernow makes the point that, "Contrary to a frequently expressed idea that the conditions and problems of India are comparable to the conditions and problems of the United States, so that the example of Great Britain in India rather than that of any European country might serve us in the United States, the writer thinks that the very opposite is true." He admits, however, that there are certain points of similarity in problems, especially those dealing with fire, irrigation, organization of extensive areas, etc. I think that Dr. Fernow does not place enough emphasis on the value of the Indian experience in silviculture. One finds in the teakpole management a counterpart of our American polewood management of hardwoods; of the longleaf pine problems in the native chir of the Himalayas, of some of our Pacific Coast problems in the management of deodar, of Rocky Mountain conditions in the spruce of the mountains, and of chaparral in the management of scrub. Their methods of working plans and their experience in administration also seem to me of great importance. Their work is of special value to the American forester also because the results are written in English. I would encourage students to study Indian forestry, not only in Dr. Fernow's history, but also in the Government reports and other publications.

Dr. Fernow has presented his material in a clear and readable style. While a great deal of it will be of interest to laymen, it is essentially designed for technical foresters who are already familiar with the principles and methods of silviculture, mensuration, and other branches of forestry. I commend this book to every forester as a valuable contribution to American literature.

H. S. G.

Traite' d'exploitation commerciale des bois. Par Alphouse Matthey. Tome premier. (Paris, 1906). 488 pp. Price, 15 frcs.

This very exhaustive and profusely illustrated treatise on forest utilization is a decided addition to the French forestry literature, enlarging on Boppe's *Cours de technologie forestiere.*

Although mainly intended for unprofessional lumbermen, some chapters are treated with a fullness which such readers hardly demand, indeed, the volume is as comprehensive and the treatment as thorough as any professional forester may demand.

The volume is divided into five books.

The first book on the constitution of wood contains in its first chapter a grouped description of many species of wood with very good illustrations of typical blocks showing schematically the microscopic structure. Some American and other exotic species are included. The second book on Faults and Diseases of Wood is particularly well illustrated with colored plates showing the discolorations of fungus diseases, and with many black prints.

A short "book" of 45 pages disposes of methods of stacking, drying and impregnating with preservatives, the weakest part of the volume. The fourth book treats of the tools, from the standpoint of the American reader also imperfectly. The last and longest book on methods of transportation is perhaps the most complete, although here too, as in all European publications, lack of familiarity with American methods is a serious detriment. Nevertheless there are many points of interest to be found which do not appear in English literature; especially interesting is a comparison of cost of transportation by different means.

B. E. F.

The Influence of Forests on the Storage and Regulation of the Water Supply. By S. Eardley-Wilmot. Indian Forest Service. 58 pp. 8° Calcutta, 1906.

The author divides his subject into two parts. I. European Research into Forest Influences. II. Application of results of European Research to Indian Conditions. Introductory to the general discussion of the subject, attention is called to the fact that during the 40 years since the creation of the Forest Service

but little attention has been given to joint influences, particularly the mechanical influence of the forest on the water supply. This was largely due to the great demands upon the Forest Service in the creation of state forests and in settling the state ownership of forest and waste lands. Also later in protecting and managing these lands.

Recently the question of forest influences has come prominently before the people of India. There is, however, but little public record based upon scientific observation in India, regarding the influence of forests on climate, water supply, etc. France is selected by the author to supply the facts and statistics bearing upon the subject. French researches along these lines have not only continued for a long time, but the French Forest Staff are giving careful attention to forest influences at the present time. Furthermore their results have only recently been made known. In France the subject is of very large importance because of the extended areas in that country threatened by the consequences of denudation.

In the first part of the paper, forest influences are discussed under the following heads:

1—Influence on air temperature.
2—Influence on soil temperature.
3—Influence on humidity of the air.
4—Influence on atmosphereic precipitations.
5—Influence on springs.
6—Influence on the amount of water withdrawn from the soil.
7—Influence on the regulation of torrents.
8—Influence on avalanches.
9—Influence on moving sands.

In the second part of the paper there is presented an interesting discussion of the river systems of India and the importance of the forests in their bearing upon variations in stream flow.

The author's Indian theories based upon European facts, are as follows: :

1—Speaking generally the water supply of India is probably more than sufficent for the requirements, agricultural and industrial, of the country if not allowed to run to waste.

2—The storage and regulation of this supply can be automatically and efficiently carried out by natural laws.

3—Provided that man permits the application of these laws, the distribution of water can be efficiently carried out by him in such localities where physical conditions do not prohibit it.

4—If, on the other hand, interference with these laws is permitted the water supply is liable to become deficient or irregular and its distribution impossible or at least difficult.

5—It is necessary therefore to aid the forces of nature in this respect and where necessary to prohibit such action as hinders or diminishes these forces with a view to reaping their full benefit in these localities when this may be possible.

By specific illustrations the forest is shown to be the most important factor within the control of man, in the regulation of water supply. Where forests do not exist or are not maintained the agriculture is dependent more or less entirely on the flow of the rainfall from the surface of the soil and it does not afford a certain livelihood to the inhabitants, consequently frequent famines are likely to occur.

A Preliminary Working Plan for the Public Forest Tract of the Insular Lumber Company, Negros Occidental, P. I. By H. D. Everett, Forester in charge of Forest District No. 8, and H. N. Whitford, Ph. D., Forester, Chief of the Division of Forest Products. Bulletin No. 5, Department of the Interior, Bureau of Forestry. Manila: Bureau of Printing 1906, pp. 54, plates XII, maps 1.

This bulletin is of special interest because it describes the first working plan made for the management of a tract in the Philippine Islands, which is being lumbered on an extensive scale. The tract described has added importance because it is being lumbered by a company organized in the United States, who propose to carry on more extensive lumbering operations than have been previously undertaken.

The tract covered by the working plan is located in the northern part of Negros Occidental and comprises an area of approximately sixty-nine square miles, ninety per cent. of which is heavily forested.

The operations are being conducted under a license agreement granted by the Philippine Bureau of Forestry which gives to the

Insular Lumber Company the exclusive privilege of cutting timber on the tract for a period of twenty years.

The tract is especially well located with reference to water transportation because the Himuguan River which flows through the tract is navigable for a distance of several miles from the coast, and lumber barges can be loaded directly at the mill, from which point they proceed to their destination without reloading.

It is one of the few places where steam logging can be carried on successfully and profitably, and it is here a necessity because the logs are too large to be handled by animals.

Three forest types are distinguished; namely, waste land type, river valley forest type, and upland forest type. The two latter are natural and the first is the result of clearings. The commercial forest is very largely composed of the upland forest type and covers broad gentle slopes and ridges leading to the foothills and peaks of Mt. Silay. The elevation above sea level varies between 150 and 1,200 feet. The forest is characterized by a dominant stand of large overmature trees belonging to the family Dipterocarpaceae. Six species of the above family comprise over 90% of the commercial trees, 16″ and above in diameter. An estimate of the standing timber on the tract showed an unusual amount of merchantable timber per acre, for a tropical forest, for nearly all the large timber is one genus and is in demand in the local markets.

The amount of standing timber was determined by making a strip method survey of 135 acres of the concession, about 1% of the area. The result showed a stand of 50,000 ft. B. M. per acre of trees 16″ and above in diameter, without making any allowance for defects.

Mangachupay *Shorea* (sp.) though constituting but 21% of the total number of trees per acre furnished 45% of the above estimate, while *Shorea squamata*, constituting 15% of the total number of trees furnished 21% more. The genus Shorea comprises 86% of the merchantable timber on the tract. This is a condition rarely met, because the forests of the Islands are usually very mixed and consist of many genera, the greater number of which are not in demand at the present time.

The timber on this tract is usually defective, being attacked by an unknown fungus. For this reason it was found neces-

sary to make heavy allowances for defects, this allowance varying with different species. Allowing for defects the average stand of timber 16″ and above in diameter per acre is 33,450 ft. B. M. and 20″ and above in diameter 32,050 ft. B. M. (Doyle's Scale). The total stand of merchantable timber is estimated at 1,207,000,000 ft. B. M.

The Insular Lumber Company has in operation on the tract a small circular saw mill of a daily capacity of 15,000 ft. B. M. and a logging outfit consisting of a fifty horse power road engine equipped with one mile of 1″ cable and 1 mile of ¾″ "messenger" cable, and a 40 horse power yarding engine equipped with 2,000′ of ¾″ yarding cable.

The methods of yarding and hauling to the rollway are similar to those employed in steam logging on the Pacific coast. The logs are floated down the river from the rollway to the mill, but a narrow gauge logging railroad is now under construction and in the near future logs will be handled from the forest directly to the mill and the road engine will then be used for skidding purposes.

The logging crew consists of one American logging superintendent who receives a salary of $2,100 per year and an American assistant receiving $2.00 per day. The remainder of the crew, forty-two men, consists of natives who receive an average daily wage of about twenty-five cents. The above crew handles from 5,000 to $10,000 ft. B. M. of logs per day at an verage daily cost of $22.50. The average logging cost per 1,000 ft. B. M. is $3.50.

The mill crew consists of three Americans; a sawyer at $2,000 per year, a book-keeper at $75.00 per month and a setter receiving $2.00 per day, and twenty-eight Filipinos receiving about twenty-five cents per day. The average daily labor cost at the mills being $21.00. The cost of manufacturing lumber and delivering it by barge, in Manila 400 miles distant, is $18.60 per M ft. B. M., of which charge transportation is $5.00 and the average government stumpage charge $1.25.

The company receives on an average more than $30.00 per M ft. B. M. in Manila for green lumber, so that the proportion shows a good profit.

The company has now under erection a 100,000 ft. double band

mill, and are contemplating the erection of a tie treating plant if contracts can be made with the railroads which are now being built to supply them.

The principal competitors of the lumber manufactured by this company will be American Redwood and Oregon Pine which are shipped to Manilla in large quantities. Oregon Pine is not well adapted for use in the tropics because it is readily attacked by the "anay" or white ant, and the product of the mill of this company should find a ready sale in large quantities in competition with this wood. It is to be hoped that the company will make a success of their venture and that in a comparatively short time the Philippines may be in a position to produce at a low price the lumber demanded by her native markets.

Large sums of money have been paid each year for foreign timber because the methods of lumbering in vogue in the Islands were too crude and inadequate to furnish, at a low cost, the construction of timbers demanded, and the advent of a corporation having the ability to install a large logging and milling plant and place native timber in the market should be welcomed with much satisfaction not only by consumers of lumber but by the government itself.

A number of tentative recommendations are made for the management of the tract which will be enforced until a more detailed study can be undertaken and other changes made which further safeguard the forest. It is proposed to adopt two different systems of management, one for lands agricultural in character and the other for lands non-agricultural in character. In the former case the forest will be treated under a clear cutting system and as fast as logged will be turned over to agriculturists for settlement. No attention will be paid to young growth and the main efforts of the inspection force will be directed toward securing the utilization of all merchantable timber on the tract.

Where the land is non-agricultural in character the selection system will be practiced, and the forest will be managed with the idea of securing a continuous yield of the six species at present forming the greater part of the merchantable stand. Care will be taken to leave sufficient seed trees to provide for a future yield but at present no provision will be made for a regular and sustained annual yield.

On the non-agricultural land the maximum diameter limit has been set at 20 inches, and all logs from trees, which have 50% of clear sound lumber must be utilized. Provisions are made for the utilization of the inferior species for construction purposes and for the payment of charges on excessive amounts of timber cut for such purposes.

The plan provides for the permanent assignment of a ranger to the tract whose duties shall be to patrol the tract and prevent forest fires and the making of clearings; to inspect the lumber operations, and to look out for the general interests of the Bureau of Forestry.

This plan while preliminary in character and, as stated by the authors, inadequate in many ways, is a stepping stone towards the better management of the Philippine forest, and as such is to be greatly commended.

R. C. B.

A Preliminary Working Plan for the Public Forest Tract of the Mindoro Lumber and Logging Company, Bongabon, Mindoro, P. I. By Melvin L. Merritt, Forester in charge of Forest District No. 5 and H. N. Whitford, Ph. D., Forester, Chief of the Division of Forest Products, Bulletin No. 6, Department of the Interior, Bureau of Forestry. Manila: Bureau of Printing, 1906. Pp. 55, plates XIV, maps 1.

A tentative working plan for the management of a tract of public forest, 55 square miles in area, situated on the south-eastern coast of the Island of Mindoro. The area at present is being exploited by a lumber company holding a twenty year license agreement. This agreement grants the Company the exclusive right to cut and gather forest products over an area of approximately eighty-five square miles, a portion of which was not included in the working plan prepared.

The forest conditions differ markedly from those found in Negros and more nearly represent the conditions found in the average commercial forest of the Islands.

The tree species are more abundant but the amount of merchantable material is much less, because of the lack of market for many species.

The map accompanying the working plan shows the extent of

the various types of forest, the latter being based largely upon the characteristic trees found within the areas.

The maximum yield of merchantable timber, 20″ and above in diameter, was found upon the "Narra" type, and amounted to 12,200 ft. B. M. (Doyle Rule) per acre. Seventy-seven per cent. of this amount was composed of species representing three genera of the family Dipterocarpeae. In an upland type of forest known as the "Hagachac" *(Dipterocarpus lasiopodus)* type the yield of timber is estimated at 11,284 ft. B. M., three species in the family of Dipterocarpeae furnishing 91% of the amount.

The lowest yield 4,464 ft. per acre, is found in "mixed" type growing in rich bottom land. The species on this type are very numerous, but large trees are scattering and species having a merchantable value, are not abundant.

A study of the tables showing the stand per acre of trees 16″ and above in diameter shows a variation between 15.8 trees per acre in the "mixed" type to 26.9 trees per acre in the "Narra" type.

Volume tables for three different classes of trees are given; namely, for Narra, a low growing tree; Amuguis a medium height tree, and one for Dipterocarpeae which are tall and straight. The value of these tables is not apparent since the author states that the figures were not secured within the tract, but were compiled from data, collected in the provinces of Bataan, Tayabas and Negros. The soil in the area studied in Mindoro is alluvial in character, while the Dipterocarpeae forests of Bataan and Negros in which the measurements were secured grew upon soil formed by the disintegration of volcanic rocks, in situ. Further, the rainy and dry seasons are very distinct in Bataan and Negros while in Mindoro the rainfall is more equally distributed throughout the year. The regions from which the data were secured are, with the exception of Tayabas, too far removed from Mindoro to safely apply figures of tree growth secured in them, to the latter province and it is doubtful if the form and size of the trees growing under such widely divergent conditions have sufficient similarity to warrant combining measurements made from them into a simple volume table.

Logging on this tract is carried on in a primitive way,

although a wooden tram road has been constructed from the forest to the beach. Water buffalo are used for skidding, and for motive power on the tram road. The character of the forest and the yield per acre are not such as to warrant the use of steam machinery, at least for the present.

The average cost of felling, and skidding to the beach, a distance of 1½ miles varies between $4.85 and $9.00 per M ft. B. M. Contracts are occasionally made at $6.00 per M ft. B. M.

The company has in the tract a portable saw-mill of a capacity of 10,000 ft. B. M., but so far only a limited amount of timber has been sawed.

The cost of lumber delivered in Manila varies between $12.50—$17.50 per M ft. B. M. and since the greater part of the timber retails at $30.00 or more per M ft. B. M., a good profit should result from their operations.

The main features of control recommended for the tract are that no Narra *(Pterocarpus indicus* Willd*)* shall be cut which are not marked by the forester and that no trees of other species, less than 20″ in diameter d. b. h. shall be cut. Rules relating to the protection of young growth are included as well as other details in regard to the time and manner of cutting and protection of the forest. The Bulletin concludes with a list of plants thirty centimeters and over in diameter found growing on the tract.

R. C. B.

Annual Report of the Division of Forestry of the Philippine Islands, for the period from July 1st, 1905 to June 30th, 1906. Major George P. Ahern, Director of Forestry, Manila. Bureau of Printing, 1906. Pp. 27, plates 16.

This report is of great interest because it deals with the reoganization of the Bureau of Forestry and discusses the character of the work now being conducted by it.

In October, 1905, by an act of the Philippine Commission the Bureau of Forestry was reorganized and the classification and appraisal of all forest products was transferred from the Bureau of Forestry, which had performed this work since the American occupation, to the Bureau of Internal Revenue.

This transfer rendered unnecessary the services of the greater part of the large force of rangers and officials connected with the

Division of Inspection and the latter division was abandoned. The office and field force of the Bureau was reduced from 171 men to 55 men, and thirty forest stations in the provinces were abandoned. The Islands were divided into 10 forest districts, each in charge of a forester, whose duties are as follows: "Mapping the district; study of the forest resources; location and inspection of cutting areas; data for a preliminary working plan for one concession in each district; official reports and other correspondence; licenses; inspection of the agricultural character of land desired to be taken as homesteads, for purchase or lease; registration and inspection of private woodlands to be exploited for the market; caiñgin or clearing permits; collection of data, giving cost of gathering forest products, transportation, labor; investigating future fields for forest exploration, etc."

In addition to the above work some of the foresters are conducting investigations along special lines, such as gutta percha and rubber production in Mindanao, Mangrove swamps and their products; caiñgins, etc.

A uniform system of mapping commercial and non-commercial forests, cultivated and uncultivated lands has been adopted, and as rapidly as possible maps are being prepared showing the topographical features and forest areas of each District.

Special silvicultural studies are being conducted and the results will be published from time to time, as sufficient information becomes available.

The act reorganizing the Bureau provided that, "For the period of five years from the date of the passage of this act, any resident of the Philippine Islands may cut or take, or hire cut or taken, for himself from the public forests, without license and free of charge, such timber, other than timber of the first group, and such firewood, resins, other forest products, and stone and earth, as he may require for housebuilding, fencing, boat building, or other personal use of himself or his family. Timber thus cut without license shall not be sold nor shall it be exported from the province where cut."

While this privilege may have proven a great boon to the poor people of the provinces, it is an unfortunate thing that in the administration of the public forests of the Islands, the Philippine

Commission should have adopted such a shortsighted forest policy.

For a period of five years the Bureau of Forestry struggled to build up a system of management and protection for the public forests which would not only render readily accessible to the people the products of the forest, but would at the same time safeguard the forests and insure their perpetuation.

The act granting the free use of timber for the purposes mentioned above, applies nominally for a period of five years, but it will be difficult to put in force more strict measures at the expiration of this period, and the way is opened for the establishment of rights of user in the forests which may prove embarrassing to the forest department at a later date.

It is a mistake to grant parties power to enter public forests and without license cut where and when they will, because their actions cannot be controlled. Indiscriminate and unrestricted cutting in a very short time will do great harm to the forest and the damage cannot be repaired within a long period of time.

The sweeping changes made in this act are unnecessary, because before the passage of the act needy residents of any province could secure, from forest officials stationed in the provinces, a gratuitous license permitting them to secure from the public forests, free of charge, sufficient timber for the construction of a house, boat, agricultural implements, etc. Such licenses could be secured by needy applicants, but parties of means were prevented from securing the free use of timber.

By the license method the control of forest operations remained in the hands of the government and the forest could be managed in a conservative manner. If the former scheme was not sufficiently elastic, it could have been made so very readily, and it is to be regretted that the law-making body of the Islands felt called upon to sacrifice the future interests of the country to the greed of the present.

There always has been opposition manifested by a considerable element of both natives and Americans against any scheme of governmental supervision and control of forest operations on public lands because such supervision and control does not permit them to exploit the forests for their benefit. No doubt it was the influence of this class of people who were not eligible to free

use of timber under the former act, which brought about the change of the law.

The class of natives who should receive the privilege of the free use of timber for domestic purposes, require but a small amount, preferring bamboo wherever it can be used because it is easier to transport and to work.

The cutting and use of timber cannot be controlled in a satisfactory manner under existing conditions, and the way is opened for the fraudulent use of timber and other forest products

The Philippine Commission which is charged with the care and wise use of the public forests has certainly laid itself open to just criticism and by the shortsighted policy adopted has shown that the Commission does not appreciate the value of the forest lands entrusted to their charge, and that they have failed to profit by the experience of the United States, whose forest resources were so recklessly handled.

It is unfortunate that a backward step has been taken in the administration of the forests of our insular possessions, for there practically virgin forests exist which if properly protected and managed would continue indefinitely to be a most valuable asset of the Philippine government.

It is to be hoped that the situation will be appreciated before it is too late and steps taken to stop the backward progress of forest administration.

In the Philippines as in various parts of tropical Asia, the practice of shifting cultivation is prevalent. Large areas of forest are annually destroyed by the natives for the purpose of clearing a small area on which a few crops are planted and the land is then abandoned.

Stern measures were adopted to stop the practice, but imprisonment and fines failed to secure the desired results. In India the forest department encountered similar difficulties, but there they have been able to turn what appeared to be an undesirable practice to good use by encouraging the natives to plant teak seedlings on the lands, before they are abandoned.

The class of natives in the Philippines engaged in making such clearings are frequently ignorant and ill informed as to the law, and but little is gained by the imposition of a fine upon them or by imprisonment because they have no funds with which to pay

a fine, and imprisonment is no hardship because they are fed without exerting themselves to secure the food.

Shifting cultivation has been practiced for so many generations that the right to practice it cannot wholly be denied the people.

The present practice of the Bureau of Forestry is to issue permits for making caiñgins, permission being refused for clearing tracts covered with large or valuable timber.

The Director of Forestry recommends that the law be changed and municipal presidents given authority to grant permits only on such areas are are designated by the Chief of the Forest District. This will prevent the clearing of lands where such clearings are undesirable and the waste of large amounts of timber each year.

Marked progress was made during the year in the investigation of market timbers by the timber-testing laboratory. In addition to the mechanical tests, especial attention was given to the behavior of the woods in the dry kiln and in various processes of manufacture.

Reliable information regarding the mechanical properties of thirty of the more important woods is now possessed by the Bureau of Forestry, and the accumulation of data on many other species has been carried on to a considerable extent.

Mention is made of the intention to establish a Division of Forest Products. Since the report was written this division has been established to carry on the following lines of work: "to investigate the amount, character, value and uses of Philippine forest products and to bring this information to the notice of Philippine and foreign markets; to make special efforts to find new uses for native woods and to bring out the useful qualities of certain abundant woods not as yet sought by the native lumberman." The field before this division is certainly a broad one and work along the lines suggested is urgently needed.

There was a marked decrease over the previous year in the number of licenses of all classes, except gratuitous, which were issued. This was largely due to the passage of the act permitting the free use of timber. The amount of timber cut under license decreased 50,000 cubic meters, and the revenues from the public forests was lower than during any previous years, except

1901, the first year the Bureau of Forestry was established. This reduction in revenue amounting to more than $32,000 was due largely to the free cutting of timber for personal use.

The Bureau of Forestry is now largely engaged in scientific work and in the examination, classification and mapping of the forest lands. But little progress can be made in the wise administration of the public forests until the act permitting the free use of timber, without license, is abolished, and the control of logging operations again placed directly in the hands of the Bureau.

R. C. B.

Mechanical Tests, Properties, and Uses of Thirty Philippine Woods. By Rolland Gardner, Manager of the Timber Testing Laboratory. Bulletin No. 4 of the Philippine Bureau of Forestry, Manila, 1906. 69 pages, seven tables, and twelve stress diagrams. Contains also three pages description of the lumber industry in the islands.

The material presented is necessarily of a preliminary nature, giving in a simple and readable form the results of tests made thus far. The publication is particularly valuable as a popular introducton to the mechanical and physical characteristics of the numerous and greatly divergent kinds of wood in commercial use. From this view alone it is established as an important publication, but it is also of interest in a lesser degree from the technical standpoint.

In the introduction by H. N. Whitford, it is stated that the results "represent the present knowledge of the subject and are not to be considered final, for such results can be obtained only from a large number of tests of properly identified botanical material from many locations and habitats."

In the beginning is given a simple and clear explanation of the methods and terms used in making the tests and calculating the various strength values which should be understandable even to one familiar with the subject of mechanics. Following this are the three principal tables of results from crossbending, longitudinal compression and shearing tests, and 11 stress diagrams of transverse compression. A few hardness tests are tabulated.

Next is given a cyclopaedic list of the species, giving their qualities, uses, derivation, and concurrent names.

In the tables in which the average, maximum and minimum values are given for each group of tests, the results are grouped into three moisture conditions, over 35 per cent., 20 to 35 per cent. and under 20 per cent. It is unfortunate that the tests were not all made in the green or soaked condition as they would then have been comparable. Judging from our American woods (See Bulletin No. 70, Forest Service. "The Effect of Moisture upon the Strength and Stiffness of Wood") the strength should begin to increase rapidly when the moisture falls below 30 per cent. and the author himself states that the strength increases quite rapidly below 30 to 35 per cent. Therefore, tests made at varying moisture degrees of less than this cannot properly be averaged. An increase of as much as 400 per cent. in strength may occur in some of our woods from the green to the very dry condition, yet in the tables in one instance tests from 1.7 to 19.2 per cent. moisture content are average together.

The column given for "moisture over 35 per cent." should therefore be used where actual strength values are wanted. In this column an average compressive strength of 8,000 lbs. per square inch is given for Ipil from Palawan, although considerable variation appears in this species, that from another locality being only 5,450 and individual specimens varying from 2,390 to 9,470. The same remarks apply to the crossbending tests of these species, although in the latter tests Tindalo comes out slightly ahead with a modulus of rupture of 15,000. Of the weaker woods Colantas from Albay has an average strength of scarcely 3,000 per square inch, and a modulus of rupture in crossbending of 5,650. Banuyo falls below Colantus in bending tests, with a modulus of rupture of 5,140, but has a compressive strength of nearly 3,300. Comparing these with our own familiar woods, green Red Spruce has a compressive strength of 2,400 and a modulus of rupture of 5,200 while the same strength values for Hickory are 6,100 and 8,800 respectively.

The table of shearing strength shows excessive irregularity, a variation of over 600 per cent. being averaged for one species. The specific gravities given in the tables are evidently not that of the dry wood, but of the green wood less the moisture.

What these figures represent is not clearly stated, but it is apparent that no account was taken of the shrinkage. Presuming these woods to shrink at least as much as our chestnut, the values given in the column headed "Specific gravity of dry wood" should then be increased by at least 10 per cent. to be what the heading indicates.

Taking them as they stand, it is a surprise to find that none of the woods average as high as .90 and but few .85. Of the lighter woods, the average specific gravity given for Lauan is .45 and for Mayapis .40. Our red spruce has a specific gravity (actual dry wood) of .41 and hickory of .89. Sequoia gigantea is as low as .29.

Johnson's "apparent elastic limit" is given also in the tables, but no good reason is shown why this value is used at all.

Quoting from the text, the author makes the following interesting statements:

"Most Philippine woods are brittle, Dungon and Malugay being the only ones which have been investigated and found to possess the property of toughness to any considerable degree."

"Yacal and Guijo are among the stiffest woods."

"A strong wood is not necessarily stiff, nor is a stiff wood necessarily strong."

Speaking of the durability of woods, the author says that "in temperate zones ten years is considered a long life for an untreated tie, but in these islands the extremely durable woods, like Ipil and Molave, are known to have been in the ground for more than ten years without any sign of decay." Arango and Betis are highly valued because of their durability in sea water where subjected to attack of the teredo.

The tests were made almost entirely upon timber purchased in the market. All beams were either 3½ by 3½ inches or four by 4 inches, with span of 60 inches. The longitudinal compression specimens were of the same cross section as the beams and 8 inches long.

The transverse compression tests were made in a similar manner to which a rail presses across a tie, but with two widths of compression blocks, so that the effect of the cutting edges is calculated as distinct from the direct compression of the fibres beneath the block. Stress diagrams for these tests are given.

H. D. T.

First Annual Report of the State Forester of Wisconsin, 1906. Madison, 1906, 67 pp.

The appearance of the First Annual Report of the Wisconsin State Forester marks an epoch in the history of Wisconsin's forests. It tells of conservative interests strong enough to pass a comprehensive code of forest laws, a state definitely committed to a forest reserve policy, and executive forces fit to cope with the Herculean task of the reboisement of the Pineries.

In the spring of 1904 Mr. E. M. Griffith of the Forest Service was appointed State forester. He entered, a lone scout in the van of forestry, as the rear of the army of Pine Barons pulled out for the South and the West. His first summer's reconnaissance revealed a considerable amount of good hemlock and hardwood still standing; but lone black ram pikes towering above a barren of charred slash, or at best a crop of fire weeds for the most part marked the trail of the despoilers of the pine. The conservative forces, led by Hon. John M. Olin of Madison, had succeeded in reserving some 40,000 acres of State land about the headwaters of the Wisconsin. A few of the more farsighted lumbermen were already considering forest replacement on their cutover lands and the paper companies were alive to the imperative need of insuring a permanent supply of pulp wood. The large water power interests, particularly of the Wisconsin River, were suffering so much from irregularity of flow that they had bought many of the driving dams on the northern lakes and were seeking to control their streams by this reservoir system. The summer folk who frequent Wisconsin's beautiful lake region, were pleading for forest protection. So the lone forester soon found allies and in the spring of 1904 Mr. E. M. Griffith of the Forest Service was appointed State Forester. Backed by the conservative interests, he went to the Legislature in the winter of 1905 and obtained the passage of the present Forest Code.

To carry out its provisions, the law provides for a State board of forestry consisting of the president of the university, the director of the geological survey, the dean of the agricultural department, the attorney general, and one other member to be appointed by the governor. They appoint the Forester at a salary of $2,500 and he selects his assistant at a salary of $1,500; their technical training being certified to by the U. S. Secretary of

Agriculture. In May, 1906, Mr. F. B. Moody, a graduate of the Michigan Forest School and a man of wide practical experience in Maine, was appointed Assistant Forester.

Fire protection was the first requisite to any forestry work. "The law provides that the State forester shall also be state fire warden and that he shall appoint one or more town fire wardens for those organized towns in which he deems it necessary. The fire wardens have the authority to call upon any citizen to assist them in fighting fires and both they and those whom they summon receive such compensation as the town board may allow, not to exceed 25 cents per hour and subject to the approval of the forester. They have the power to arrest without warrant and, most important of all, can absolutely prohibit the setting of any fires during a dangerously dry time." The system has been in operation hardly long enough to pass judgment upon it. Over 300 wardens have been appointed and 20,000 notices posted. Their reports for 1905 show 160 fires, 76,000 acres burned, the service costing $1,500. Most of this area was cutover land which the people not unnaturally regard as fitted only for their pyrotechnics. The information as to origin is rather meagre, but indicates that 60 per cent. of the fires are caused by settlers clearing land and burning for pasture, and 17 per cent. by campers. An admirable feature of the law is that it admits of cooperation between the State and lumbermen as is done so beneficially in Maine, and it is highly encouraging that the railroads have been eager to assist the State wherever possible.

Trespass on State and Federal land has been one of the blackest spots in the history of the State, a crime fostered by a lenient government too largely controlled by the lumber kings. A halt has been called. Double stumpage values are now collected and criminal as well as civil action brought, and as the forester says: "The man who deliberately steals timber is gradually coming into his own, and is looked upon as twin brother to the horse thief."

But even more significant than these important protective measures is the creation of the forest reserves. All State lands in the northern part of the State, some 234,000 acres, have been turned over to the board of forestry. In addition, Congress passed Senator La Follette's bill granting 20,000 acres of vacant government land, justifying the gift from the fact that the Wis-

consin reserves control important tributaries to the Mississippi. It is a cardinal policy of the State that only absolute forest land shall be reserved, the forester being empowered to sell all agricultural land and scattered forties. The proceeds from sales of State lands together with the receipts from all forest products constitute a fund which shall be disbursed only for the purchase of lands to be added to the reserve, for its protection and improvement, and the employment of the necessary assistance therefor. Moneys from the sale of Federal lands is to be used only for forest replacement on the permanent State reserves.

The control of stream flow is determining the selection of lands. A fairly compact body of 130,000 acres has been chosen about the splendid lakes in which the Wisconsin and Chippewa systems head. A second reserve is being formed about the St. Croix, and the State has been promised the donation of a considerable area along the Brule. Some 47,000 acres of Indian lands, comprising the finest forests remaining in Wisconsin, are claimed by the State under the swamp land grant of 1850; but however the title is decided, the lands will be conservatively lumbered in coöperation with the Forest Service.

Not the least of the forester's effort has been directed toward instructing the people, upon whose enlightenment depends the ultimate solution of the vast problems of the pineries. The latter half of the report sets forth in simple words the basic principles of forestry, vindicated always on the ground of sound finance.

Such are the achievements of the conservative forces which Mr. Griffith has led for less than three years. He and the people he serves are indeed to be congratulated on having so vigorously grappled the task; at last proclaiming the welfare of the State to be above the spoilers' unchecked greed. R. F. N.

Second Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii. Honolulu, 1906. 240 pp.

The most important work done by the Division of Forestry in Hawaii in 1905 was the creation of forest reserves. Besides the two reserves set aside in 1904, three new ones were created in 1905 and two more up to March 1906, the total area of these seven being 68,901 acres. These reserves have been accurately

surveyed and mapped and the principal points on the boundaries marked with permanent monuments. They will be constantly added to as the government leases expire. The planters are becoming more interested in forestry through the enthusiastic and most creditable labors of Mr. Ralph S. Hosmer, Superintendent of Forestry and one firm has already turned over to the Board the management of some of its forest land.

In forest extension, advice and assistance has been given in the form of planting and working plans and the distribution of seeds and seedlings at cost. Three rubber plantations have been started on the island of Maui, the Ceara rubber being mostly planted. November 3 was proclaimed by the Governor as Arbor Day, and 3,554 plants were set out by school children on that day.

A new forest fire law, modeled upon that prepared by the U. S. Forest Service for California was passed. While this law provides admirably for a fire-fighting organization and establishes penalties there is no money available for carrying out its provisions.

Some of the Koa forests are being lumbered by private concerns under regulations such as the observance of a diameter limit, protection from fire and of young growth, and prevention of waste, imposed by the Superintendent of Forestry.

Very durable telephone insulator pins are being manufactured at Hilo from the native Ohia Lehua. An interesting experiment in the durability of treated and untreated ties of the exotic Ironwood *(Casuarina equisetifolia)* was started in coöperation with the Oahu Railway and Land Company.

The interesting reports from the District Foresters on the several islands show that forest areas exposed to the ravages of cattle are more susceptible in their weakened condition to the attacks of insects, but that when once protected from cattle and fire these areas will soon revert to a healthy and vigorous growth of native trees. On the island of Kauai from one district over a hundred head of cattle roaming wild in the woods were exterminated.

Through the energetic work of Mr. Hosmer the creation of new reserves will still hold first place. The next step, a most important one, is to establish a proper system of forest reserve ad-

ministration. So far, the reserves have been practically only on paper, but it is to be hoped that the coming Legislature will appropriate sufficient funds to enable Mr. Hosmer to carry out his plans for an efficient ranger service for the administration of the reserves.

C. S. J.

Report of Forest Commissioner, Maine, 1906. Augusta, 1906 pp. 218.

This report closely resembles preceding biennial reports. The brief notes on trees are an innovation, and an amplification of the information concerning each species, would make this part of much greater value in future reports. Professor Tower's working plan for Indian Township is an excellent piece of work and should be of value to owners of similar tracts of forest in eastern Maine. The major portion of Bulletin 24 of the Forest Service is included in the report with the purpose of extending elementary knowledge of forestry. The illustrations throughout the volume are well chosen and add greatly to the value of the various articles published.

In connection with the portion of this report dealing with the progress of forestry in the State, some facts are of especial interest. Until 1903 progress in practical measures of State forestry had been slight. In that year an appropriation was made to begin educational work in forestry and to carry out a system of fire protection for unincorporated townships. The fire warden system was modified in 1905 to provide better fire protection by dividing the State into districts in which the fire wardens report directly to the chief warden and he in turn to the commissioner. The chief wardens are given the right of arrest without warrant. The most important part of the law was the provision for adequate fire patrol in seasons of great fire danger. The 1906 report shows that the system, thus inaugurated, is efficient. An additional point of interest is the success of lookout stations. Several of these have been established on suitable points and maintained by cooperation of the State with certain lumber companies. The use of a range finder for locating fires from these stations and the reporting of fires by direct telephone connection with the house of the chief warden have been successful, and these measures may well be utilized in other States.

Educational work in forestry has been centered in the State University. Outside of this, lectures of instruction have been given to a limited number of clubs, farmers' granges, and normal schools in the State.

The recommendation of Professor Tower in the 1906 Report that Indian Township, Washington County, be made a State Reserve would inaugurate a new policy of great value to the State.

One phase of forestry as yet untouched is the practical cooperation by the State with landowners in making plans for forest management of woodlands and for forest planting. There is great need for such practical instruction in forestry in southern Maine, especially, and in other parts of the State. Much wider general instruction for the people by means of addresses is also essential. This work naturally constitutes part of the duties of a State Forester, and it cannot be expected that the professor of forestry at the State University can perform such work in addition to his present duties.

The next step in the progress of forestry in Maine should be the apointment of a technically trained man as State Forester in the State Department of Forestry. Besides the duties already mentioned the State Forester would be of great assistance to the Commissioner in directing the forest fire service of the State and superintending work on State Reserve land. A movement is now on foot to form a Maine Forestry Association, and such an organization should encourage this further development of forestry in Maine.

S. N. S.

Report of the State Forester of California, for 1905 to 1906. Sacramento, 1906. 39 pp.

Those who have followed State forestry work and especially those who are interested in systems of fire protection, will welcome the first public report of the California State Forester.

The office of State Forester was created March 18, 1905, and the first officer, Mr. E. T. Allen was succeeded by Mr. G. B. Lull, the present incumbent on July 1, 1906.

The report covers the entire period since the creation of the office, and is presented in such an order and in such a manner, as to illustrate the arguments and aims of the forester.

The first part of the report is largely educational and discusses the effect of fire on the forests of the State, the influence of forests on stream flow, and the function of the State in regulating its resources.

A brief retrospect of the forestry movement in the State, as well as a sketch of the co-operative work between the Forest Service is given.

So far no technical forestry has been accomplished by the State, but a planting plan for one lumber company is now in preparation.

The all absorbing problem so far has been that of fire protection. The present system which was drawn up carefully under the guidance of the Forest Service and modified somewhat before passage by the State Legislature provides for fire districts, and wardens to be appointed by the forester for these districts.

Wardens do not patrol, but have the power of arrest and serve without pay, unless remunerated by private individuals or counties. Efforts have been made to persuade each county to appropriate money to repay the wardens for actual service performed. So far only ten out of thirty-seven counties have responded. Three of these have appointed their Game Wardens, chief fire-wardens, with patrol duties, and this has proved to be the most satisfactory method. The wardens in the other seven counties are paid only for time spent in fighting fires, and aside from the posting of notices, nothing is done towards prevention.

The present system was considered more or less of an experiment, and has served its purpose in as much as it has established a forest fire-warden system, although not a perfect one, yet one, the good results of which the people apreciate, and it has secured this protection at a minimum cost to the State.

Probably, only in such a State as California where its citizens are accustomed to propagandist work, and where private individuals often serve the public free, could the present system of voluntary fire wardens be of any practical value.

The wardens generally have performed yeoman service, in distributing circulars containing the laws, in posting warning notices, and in fighting fires, but they are not efficient in convicting offenders against the fire laws, and naturally are not required to patrol.

Magistrates also are loth to involve the counties in the expense of prosecution, so that arrests and convictions are few and confined mainly to the southern counties where timber is scarce.

Most of the fires occurred during the dry period from May to November, and from the 120 reports sent in to the forester's office, the following causes were attributed:

Unknown and miscellaneous,	51.02%
Sparks from engines,	14.18
Clearing land,	10.00
Camp fires,	10.00
Lightning,	8.33
Maliciousness,	4.16
Logging,	2.5

The forester recommends several changes to the existing laws, the more important of which are briefly:

1. That the district wardens should be salaried patrolmen, having no other business.

2. That the State Forester should have control over these positions.

3. Reliable citizens desiring powers of wardens should still be appointed, but only district wardens should be empowered to compel assistance in putting out fire, and this work should be paid at the rate of 25 cents per hour.

4. In case the county is willing to co-operate with the State, they should share equally the cost of the system of protection, but in case a county fails to co-operate and still there is need of protection, wardens should be appointed, and the State should assess the county one-half the expenses, but retain all the fees from fines as in the present law.

A definite system of fire protection has been worked out in the California Redwood Park where a fire line 30-60 feet wide runs around the tract for 28 miles, and has cost from $150.00 to $175.00. In addition to the lines surrounding the park, several short secondary lines have been cut along cross spurs inside the park, to form further barriers in case a fire crosses the outside lines.

As a further precaution a paid warden and other employees keep strict watch over campers and visitors, to prevent any outbreak of fire. It is encouraging to point out that during the last

two years of this policy no fires have crossed over the lines into the park.

In his report Mr. Lull has succeeded in touching upon nearly every phase of forestry work in California, and the report aside from its educational value, is a good index of the scope of forestry work in that region. F. B. K.

Fourth Annual Report of the Society for the Protection of New Hampshire Forests, for the year 1905-1906. 81 pp.

The report of this society shows a large and increasing interest in the forestry situation in New Hampshire, largely brought about by the activity of this society. Among its achievements during the past year are:

1. Aid toward securing a National Forest Reservation in the White Mountains. The bill has passed the Senate and has been favorably reported to the House by a unanimous vote of the Committee on Agriculture.

2. The educational work of the society in New Hampshire has continued by means of addresses, the distribution of literature, etc.; as in previous years.

3. The forester has examined many pieces of woodland, making for some of them maps and plans for conservative cutting. These include two of the largest islands in Lake Winnipiseogee, one of which would otherwise have been swept clean. The forester of the society has been made the forester of Dartmouth College and has charge of the college forest of twenty-six thousand acres of land in northern New Hampshire.

4. In the spring three plantations of white pine were supervised.

5. Three nurseries of white pine and spruce seedlings have been established, germinating in the spring of 1906 nearly half a million seedlings.

6. A study has been made of the forest work of other States in the Union, a printed statement of which occurs in the report.

Included in the printed report are a number of articles of considerable importance relative to the details of the Forest Reservation bill before Congress, the forest fire situation in New Hampshire, the present and future prospects of forestry in the State, the effect of logging on reproduction and a discussion of forest

and fire legislation. In this last mentioned article the executive committee has brought out the important features of the forest laws in Maine, Massachusetts, Rhode Island, Vermont, Connecticut, New York, Pennsylvania, Maryland, Indiana, Iowa, Louisiana, Michigan, Wisconsin, Minnesota, Colorado and Utah, Washington, California and Canada and has shown how New Hampshire may profitably draw from the examples of these States a set of laws which will insure more protection from fire and inaugurate a forest policy fitted for the particular needs of the State of New Hampshire.

The fifth annual meeting of the society was held at Concord, N. H., in May, 1906, when the usual routine business was transacted and reports of committees and officers received, followed by addresses from Mr. Asa F. Williams, forester of the Berlin Mills Co., on "Influence of Logging Upon Natural Reproduction," and by Dr. Hopkins, of Washington, on "Insects Injurious to the Forests of New Hampshire."

The people interested in the welfare of New Hampshire seem to be waking up to the needs of greater activity throughout the State by efficient laws, encouragement to private lumbering concerns and individual owners. The Society for the Protection of New Hampshire Forests deserves great credit for its work of the past year. With this co-operation and encouragement, and the natural facilities of the State for forest growth, the future seems very bright for New Hampshire. J. H. F.

The First Annual Report of the Commission of Forestry of Rhode Island. Providence, 1907. 12 pp.

This report is interesting as representing the first effort put forth by that State towards the establishment of a forest policy. It is written in a clear and pleasing popular style and contains many suggestions for the future work of the State, but no contributions of technical importance to foresters.

Review of Forest Administration in British India, 1904-05. Calcutta, 1906. 61 pp.

This report shows that marked progress has been made in India in every feature of forest management. The total area of

forest land now under the management of the Forest Department amounts to 232,941 sq. miles. Working plans are in operation on 37,977 sq. miles, nearly 4,000 square miles being added each year. There is an attempt to protect from fire 39,464 sq. miles, successful on 95.4 per cent. Grazing is permitted on 195,138 sq. miles, although on a portion no browsers are admitted. The total number of grazing animals on public forest land is upwards of 13,000,000 buffaloes, cows, bullocks, goats, sheep, and camels. The financial returns are greater than ever before. The net revenue was 11,062,094 rupees, 54 % of the gross receipts.

H. S. G.

The Quarterly Journal of Forestry. Volume 1. London, 1907. $1.

This publication replaces the "Transactions of the Royal English Arboricultural Society, and the Irish Forestry Society." It is designed, not only to present the Transactions at the Association meetings, but to contain original articles and book reviews which could not be included in an ordinary annual publication. The publication of this journal is an indication of the growing interest in forestry in England. It is edited by a Board of Editors, of which W. R. Fisher of the English Forest School at Oxford is the head. The first number contains a number of original articles, chiefly of local interest in England. H. S. G.

OTHER CURRENT LITERATURE.

Report of the Chief of the Bureau of Forestry of the Philippine Islands, 1905. From the Report of the Philippine Commission, part 2, pages 265-290. Bureau of Insular Affairs, War Department. Washington. Government Printing Office, 1906.

Opportunities for Lumbering in the Philippine Islands. Bureau of Forestry, Circular No. 1. Manila, P. I. December 1, 1906. Government of the Philippine Islands. Department of the Interior. pp. 5.

Forest Nurseries and Nursery Methods in Europe. By William F. Fox. Reprint from the Eighth and Ninth Reports of the Forest, Fish and Game Commission. State of New York. J. B. Lyon Company, State Printers, Albany, N. Y. pp. 34, plates 12. This publication contains an interesting description of nurseries, in various parts of Europe, which were visited by the author.

Rules and Specifications for the Grading of Lumber. By. E. R. Hodgson. Bulletin No. 71. U. S. Forest Service. Washington, 1906, 127 pp.

Brief Review of the Depredations Upon the Adirondacks Accomplished or Attempted During the Past Few Years. Circular No. 9 of the Association for the Protection of the Adirondacks. New York, 1907.

Contributions from the United States National Herbarium, volume X, part 3. Studies of Mexican and Central American Plants No. 5. By J. N. Rose. Washington, 1906. 132 pp.

A Study of Rhus glabra. By Edward L. Greene. Proceedings of the Washington Academy of Sciences, Washington, December, 1906.

Wolves, in Relation to Stock, Game, and the National Forest Reserves. By Vernon Bailey. Bull. No. 72, U. S. Forest Service. Washington, 1907. 31 pp.

Transactions of the Royal Scottish Arboricultural Society, vol. XX, part 1. Edinburgh, 1907. Contains among other interesting articles: Preparation of Working Plans for British Woodlands, The Large Larch Sawfly, and Notes on Continental Forestry in 1906.

Note on The Chilgoza Forests of Zhob and the Takht-i-Suliman. By. E. P. Stebbing. Forest Bulletin No. 7, Calcutta, 1906.

Instructions to Engineers of Timber Tests. By W. Kendrick Hatt. Circular No. 38, U. S. Forest Service. Washington, 1906. 55 pp.

Forest Planting in Eastern Nebraska. By F. G. Miller. Circular No. 45, U. S. Forest Service. Washington, December, 1906. 32 pp.

Holding Force of Railroad Spikes in Wooden Ties. By W. Kendrick Hatt. Circular No. 46. Washington, December, 1906. 7 pp.

Strength of Packing Boxes of Various Woods. By W. Kendrick Hatt. Circular No. 47. Washington, December, 1906. 8 pp.

Kiln-Drying Hardwood Lumber. By Frederick Dunlap. Circular No. 48, U. S. Forest Service. Washington, 1906.

Timber Used in the Mines of the United States in 1905. By R. S. Kellogg. Circular No. 49, U. S. Forest Service. Washington, December, 1906.

Wood Used for Distillation in 1905. By H. M. Hale. Circular No. 50, U. S. Forest Service. Washington, 1906. 3 pp.

Wood Used for Veneer in 1905. By H. M. Hale. Circular No. 51. Washington, 1906. 4 pp.

The Lumber Cut in the United States in 1905. By S. R. Kellogg. Circular No. 52, U. S. Forest Service. Washington, 1906.

Wood Used for Tight Cooperage Stock in 1905. By H. M. Hale. Circular No. 53, U. S. Forest Service. Washington, 1906. 8 pp.

Effect of Moisture upon the Strength and Stiffness of Wood. By Harry Donald Tieman. Bulletin No. 70, U. S. Forest Service, Washington, 1906. 14 pp.

PERIODICAL LITERATURE.

In Charge:

Botanical Journals.....R. T. FISHER
Foreign Journals .....B. E. FERNOW, R. ZON, F. DUNLAP
Propagandist Journals .....H. P. BAKER
Trade Journals .....F. ROTH and J. F. KUMMEL

BOTANY AND ZOOLOGY.

Tree Forms.

A photograph of three spruces, standing together on a pasture near Le Locle, Switzerland, are remarkable exhibits of the variability in form of that species, which has been designated by Schröter as the most variable of European forest trees. Of the three trees, which Pillichody describes the most inexplicable fact is their occurrence side by side, the one a broad-crowned rather open-branched, tall tree of 90 feet, the second a narrow columnar crown with somewhat pendulous branches of 80 feet, the third a short stumpy, almost globular very compact form of about 60 feet height; all three between 32 and 36-inch diameter, and between 100 and 120 years of age.

What accident, the author asks, brought these three forms here together? If the columnar form owes its shape to the abundant snowfall, how could its companion develop its broad expanse of branches? If the wind is responsible for the compact globular form of the third, how have the other two escaped its influence? What is to be thought of adaptation to local conditions? And why did the tree with the broadest branches attain the greatest height, overreaching even the columnar form? No theories of explanation are offered.

Ein Spiel der Natur. Schweizerische Zeitschrift fur Forstwesen. November, 1906, pp. 335-337.

Annual Leaf Fall.

The biological causes of the annual leaf fall, which according to Wiesner is supposed to be due to reduced transpiration, is on the hand of experiments explained by Dingler to be caused by the physiological age of the

leaves. He removed on a number of trees of some nine species, in January and February, all branches, even the smallest that bore buds, and the top, leaving only naked boles. In these the leafing out not only, but the leaf fall took place much later than in the individuals left unimpaired for comparison. Leaves of the trimmed Blue Beech did not freeze in spite of a frost of several days duration. Not only the size of the leaves due to the more favorable relation of roots and buds, but to a degree also the persistence of the leaves on the trimmed trees continued the second year.

Versuche und Gedanken zum herbstichen Laubfall. Bericht der Deutschen Botanischen Gesellschaft, 1905.

Functions in Winter.

Winter rest, it appears from investigations of Simon and others, and cessation of functions may be due to internal disposition or to climatic changes. An autogenous rest pertains to diameter growth which is ended in August. A really autogenous rest also belongs to the buds of the year and, with exceptions, to poorly developed basal buds, but other buds for instance of oak and basswood may be started into life during the rest period by proper conditions. Of especial and practical interest is, that while the cambial meristem has in general a strongly accentuated rest period, it is capable of reacting to wounds by callous formation during the whole rest period. Bark (of Ribes for instance) may be induced to form proliferations even without wounding it at any time in the winter.

While most meristem remains totally inactive, remaining in forced idleness, this is less pronounced in the root tips.

Neither the wandering of materials, nor the respiration ever ceases, and under favorable conditions these functions may attain considerable intensity, possibly dependent in this respect largely upon the amount of reserve materials at disposal of the plant. A long continued frost produces increased respiration.

Untersuchungen über das Verhalten einiger Wachstumsfunktionen sowie der Atmungstätigkeit der Laubhölzer während der Ruheperiode. Jahrbuch für wissenschaftliche Botanik, 1906, H. I.

Movement of Sap.

The question as to the forces at work as well as the passages participating in the movement of sap in trees, still remains only partially answered. Ursprung finds living cells do not always but do sometimes participate in conducting water. In most of the investigated stems and branches the lifting force of the living cells was operative except in the bast cells of beech. Living wood cells are necessary to aid in conducting water through the whole length of the stem, if they are killed the rest of the conducting tissue does not carry sufficient water. In comparison to the purely physical forces the author attributes a very great significance to the lifting power of the living cells.

[This finding lends color to the theory of the editor that eventually it will be found that water movement is probably almost entirely dependent upon food movement and that the latter is not, as at present held, confined to certain tissues. The necessity of sawing through the sapwood of sap wood trees in order to kill them depends on this theory. B. E. F.]

Die Beteiligung lebender Zellen am Saftsteigen. Jahrbücher für wissenschaftliche Botanik, 1906.

Age of Trees in the Open.

In connection with the description of a Linden tree of unusual dimensions situated near Breingarten in the Aargau, namely with a diameter of 8 feet and 90 feet in height in perfectly vigorous condition, Dr. Fankhauser raises the question in general of the estimate of age of trees grown in the open. Conflicting testimony regarding the time of planting of this particular tree places the age between 128 and 180 years, an apparently low age for the size. But the author adduces a number of examples, which show that dimensions of trees grown in the open mislead in estimating the age. Thus an oak with about 5 feet diameter which had been estimated at 300 to 400 years, counted 105 rings, some an inch in width; another of 10 feet diameter, supposed to be over 1,000 years old was found to be 250. Elms of 3½ feet diameter were only 82 years old. English walnuts of similar dimension, supposed to have been planted 600 years ago were found between 100 and 145 years. old.

Two spruces, growing on precisely the same site, the one entirely in the open, the other a co-dominant tree in close forest both exactly 25 m high were felled and carefully measured and analyzed, to establish a relationship between the amount of foliage and the mass production, or inferentially between crown development and age.

The open-grown spruce produced 3105 Kg of branch wood and brush and 1170 Kg or 137 million needles, 117,000 to the Kg. The one from the forest produced only 292 Kg. branch wood and brush with 95 Kg. or 14 million needles, 146,000 to the Kg.

The first with 80 annual rings had a diameter of 23 inches, and a total of wood of 4.25 m^3; the second had in 120 years attained only 14 inches diameter and a total wood content of only 1.22 m^3, and in the 80th year its contents were only .40 m^3, hardly one-tenth of the open grown tree. While the weight of foliage of the two trees was as 100 : 8.1, the amount of wood was as 100 : 9.4. If allowance is made for the probable damage to the open grown tree by cattle during the first 20 years, these relations are indeed close.

Ueber das Alter freistehender Bäume. Schweizerische Zeitschrift für Forstwesen, January 1907, pp. 1-12.

Witches' Broom on Douglas Fir.

A fungus disease, which had been supposed to be specific on *Pseudotsuga taxifolia,* has been found by Dr. Zederbauer to be the same as *Botrytis cinerea* of the European fir and spruce. The young shoots are infected in spring and summer and, collapsing, hang down with their dead needles spun over by gray mycelium, black sclerotia appearing on them in large numbers. Usually only side shoots are attacked and when at the base of the dead shoot some 3 to 5 dormant buds develop making short shoots in the same or following year, to be again attacked and replaced by repair shoots, the result is a witches' broom.

[The Editor has seen in Southern Oregon a Douglas Fir forest of old timber in which for miles apparently every tree was full of witches' brooms undoubtedly due to fungus disease, whether specifically the same or not.]

The disease is very infectious. In the nursery spraying with copper poisons will arrest it, or else the removal of infected plants.

Die Folgen der Triebkrankheit der Pseudotsuga Douglasii Carr. Centralblatt für das gesammte Forstwesen. November, 1906, pp. 459-462.

Blood Beech.

The form of *Fagus silvatica,* known as *var. sanguinea,* Copper Beech or Blood Beech had been supposed to have been first and alone found in the forests near Sondershausen, Thuringia, and that this tree, now estimated 200 years old, had furnished all the progeny of blood beeches. It now turns out that in 1680 and again in 1706 three beeches with red leaves were noted at Buch in the canton of Zurich; and a legend among the people has it that where they stand five brothers were murdered and as a result five beeches sprinkled with blood had grown up, of which the three remained. At present only one has survived without any progeny. There is also reported from the mountains at Roveredo in South Tirol that blood beeches are frequently found.

It is, therefore, probable that this variation originated in several localities independently.

Die Blutbuchen. Schweizerische Zeitschrift für Forstwesen, November, 1906, pp. 340-342.

Mexican Conifers.

The well known publication of illustrations of vegetation by E. Stahl brings in its third volume, second series well executed pictures of Mexican conifers, by Karten and Schenk. These Mexican conifers comprise 3 species of *Cupressus,* 5 species of *Juniperus,* one each of *Taxus, Taxodium, Pseudotsuga* and *Abies,* and 17 species of *Pinus.* Of these, *Pinus patula, Taxodium mucronatum, Cupressus Benthami* and *Abies religiosa* are represented on six sheets.

Mexikanische Nadelhölzer. C. Stahl, II Reihe, Heft 3.

SOIL, WATER, AND CLIMATE.

Forest Influence on Water Flow.

At the meeting of the International Association of Forest Experiment Stations, Prof. Engler reported on the observations of the Swiss Station regarding the run-off from forested and de-forested slopes. The observations were made for three years by tri-daily readings in specially constructed drainage channels, afterwards by self-registering "limnigraphs" and 3 rain gauges (at three elevations), in addition to one self-registering. Two areas, one of about 140 acres, the other 175 acres were brought in comparison, lying between 910 and 1260 m elevation, the former to the extent of 97% forested, of which 71% old timber, spruce, fir and beech, the latter 68% in meadows and pasture, 32% forested with conifers, mismanaged wood lots. Although the geological formation and character of the slope were nearly alike, there were slight differences in favor of the deforested slope, in that it had more, and more constant flow of springs and more terraces, which retard the run-off, than the forested slope.

Altogether, the speaker pointed out, it is almost impossible to secure identical conditions, in which only the forest cover differs.

The measurements of the run-off were made in channels by measuring the heights over weirs according to the formula $q = m \times 1 \times h\sqrt{2gh}$, or else by measuring small quantities from time to time in gauged reservoirs, (limnigraphs); at each water station there are three run-off channels, which can be closed by a gate, so that the water may be made to flow through one, two of three channels, an electric apparatus regulating the opening. One of these channels is made to be self-recording by a pointer on a float, which registers every five minutes.

Conclusions on three points were reached, namely as to the influence of forest cover in very intensive rain falls, in rapid melting of snow, and on springs during dry seasons.

Since floods depend on maximum water stages, their observation is specially important. For the behavior in the very largest rainfalls that may be experienced data are still absent, but for usual high water stages the measurements, corrected for differences of condition, show *that 30 to 50% less water runs off from*

the forested slope. Especially in the beginning the difference is very large, the run-off from the deforested slope being very much larger than from the forested one, later there comes a time when more water flows from the latter, as is to be expected, the time element as well as the quantity of run-off varying.

This variation is also noted in rapid thaws, although it is not so great. During snowy weather the run-off is very even, increasing in the afternoon. Snowfall reduces and retards run-off, so that, although precipitation is greater in the mountains, changing into snow prevents floods in the mountains.

"In the torrents thaws do not have much significance; but in the rivers large water masses accumulate, and if the thaws are sudden, floods may be occasioned. At such times ponds and lakes in the mountains play a great role in retarding the flood waters."

The longer continuance of springs during dry periods on the forested slopes was satisfactorily demonstrated.

Prof. Bühler in addition reported from the Wurtemberg Station on observations regarding the drying out of soils under vegetation, to the effect that a much lower ground water level was found under forest growth than in meadows. Ebermayer and Hartman in Bavaria had found no difference between forest and field as regards ground water level, while Ototzky in the steppes of Russia, where as in Tubingen low rainfall prevails, came to the same result as Bühler.

Fünfte Versammlung des Internationalen Verbandes forstlicher Versuchsanstalten. Centralblatt für das gesammte Forstwesen, January, 1907, pp. 35-40.

Classification of Humus.

At the International Association of Forest Experiment Stations, which convened in September, 1906, in Wurtemberg, an interesting exhibition of different forms of humus, 369 samples in all, typical for a great variety of localities in all parts of Germany, Denmark and Hungary was made. The object was to furnish a basis for classification and formulation of a uniform nomenclature, which the Association has undertaken. The samples were exhibited in boxes, 50x16x10 cm., showing six differentiated and separated (by tin sheets) layers, namely, 1. the top layer of leaves, moss, heather,

huckleberry, grass, etc.; 2. the layer of litter in which humification has begun; 3. the upper layer of soil mixed with remnants of litter, etc.; 4. the layer darkly colored by humus; 5. the layer highly colored; 6. the next deeper uncolored layer of soil.

The most complete series, from Wurtemberg, comprised samples from all formations, all localities and climatic regions, ages, species of trees, etc., so that *e. g.* the spruce humus from lowest elevations to 1,000 m., from driest localities (700 mm.) to the wettest of the Black Forest (2,000 mm.) was represented.

In this connection Dr. Potonié, whose classification of humus formations was briefed in vol. IV, p. 323 of the QUARTERLY, explained the formation of bog-iron ore (Ortstein) and other so-called bioliths, rock formations in which plant organisms participate. These combustible bioliths are classified in three groups, sapropelites, humus rocks, and pyromonimites (amber).

The sapropelites originate in stagnant and half stagnant waters under exclusion of oxygen, by deposit of water plants (plankton) and oily algae, they consist of fats and oils and not of carbohydrates. If the water is rich in lime, lime organisms (algae) grow and settling on the ground form "sea chalk." If the water gradually loses the lime a chalky mud forms at the bottom, the so-called saprocoll, a gelatine-like or rubber-like tarry mass, and if silica-organisms are present a silicate (Kieselgur).

The second class, humus rocks, originate from carbohydrates, on the sapropelite deposits when these reach the surface of the water; these then form boggy surfaces on which a vegetation of Scirpeae, cattails, etc., establishes itself and by their decay turf of varying description originates, varying as sapropelite components decrease; finally as the soil becomes securer tree growth establishes itself and a swamp forest turf forms. When this has grown away from the influence of the ground water level, a new vegetation, of mosses (sphagnum), comes in and, quickly increasing, prevents further tree growth.

Potonié explains especially the origin of Alpine humus, which has been hitherto obscure; it is a raw humus of friable or granular nature, washed down to lower levels, on which tree growth thrives well. In Alpine situations on account of the humidity of the air always raw humus is formed, which through the masses

of snow is compressed and pushed downward, opens up and is exposed to the air when it becomes granular and is washed to lower levels forming deep deposits. It is in these washed turf formations that amber of recent origin *i. e.* resin of spruce and pine are found.

Fünfte Versammlung des Internationalen Verbandes forstlicher Versuchsanstalten in Wurtemberg, 1906. Centralblatt für das gesammte Forstwesen. January, 1907, pp. 30-33.

SILVICULTURE, PROTECTION, AND EXTENSION.

Influence of Light.

At a meeting of the Silesian Foresters Association the question of the significance of light requirements was discussed, depreciating its importance.

"The trees which are designated as intolerant can also grow well under cover and under side shade; not the light but also other conditions of life must be considered, especially the competition of other trees, whose roots remove moisture from the soil. If this competition is removed—if *e. g.* pine volunteer growth under the cover of older stands is surrounded by a ditch of 10 inch depth, cutting through all the roots of the old trees—the volunteer growth develops remarkably in spite of the shade." Further investigation of the light requirement theory is to be recommended.

Another speaker points out that volunteer growth is often absent in very open pine stands, in which he usually found stout shallow roots pervading the top soil, keeping it dry.

By carrying out the proposition of ditching, not only did the soil flora change, but poor volunteer growth at once doubled the length of its annual shoots and needles. As a result of this observation he had begun to regenerate large areas of pine by this means, contemplating a regeneration period of 70 to 80 years. To reduce the cost of the ditching the regeneration is to be made in continuous strips, these strips to be half the height of the old timber wide and running East to West, when the humus is kept moist and the young crop in the half shade develops a slender clear growth. To be sure, these strips also invite grass, which

may become injurious. [For an extended review of these ideas see FORESTRY QUARTERLY vol. II, pp. 226-230.

Versammlungen norddeutscher Forstvereine. Allgemeine Forst-und Jagdzeitung. November, 1906, pp. 387, 288.

Silvicultural Notes.

The experiences in plantations during the prolonged drouth which prevailed in Switzerland last summer leads Dr. Fankhauser to point out some silvicultural suggestions, applicable everywhere. The finest plant material, if not carefully handled, from nursery to plant hole succumbs, hence especially in drouthy years material grown nearby, even if not as fine is preferable as it is easier to protect it against drying out. The results with fresh, untransplanted stock, except where weed growth calls for transplants, have been satisfactory in many places. Dug material from natural regenerations is most unsatisfactory, especially in drouthy years.

The author asks why the cheaper sowing seems to have been superseded by planting, pointing out good results in various places (not on the dry limestone soils!), and that even if the sowing fails once or twice, it is so cheap as to permit several repetitions and yet be less expensive than planting.

A special point is made on the value of a protective cover (Schutzholz); nowhere did plants suffer when planted under such cover.

"Instead of allowing a plantation on poor soil and exposed position to worry along for decades or to see it decimated by frost and drouth, it would be more practical to follow nature, to first establish a nursecrop of easily started species and introduce the more valuable species later under its protection. A loss of time is hardly experienced, since it is fully offset by the better development. Nor is there any greater cost, since the total number of plants is but slightly increased, or the nurse crop can be sown. Moreover often volunteer growth will come in, and only a filling out is required.

Altogether natural volunteer growth appears to the author often all sufficient to rely on for reforestation, quoting Broillard: "That a slope reforest itself, it is mostly sufficient to leave it alone and for a few years keep out the cattle. From year to

year the area will cover itself more and more with a regeneration and soon will outgrow other vegetation."

[This advice should be accepted with caution in the United States where unfortunately weed trees and other weed growth is more prevalent and ready to take possession than in Switzerland. B. E. F.]

Einige Erfahrungen aus dem Kulturbetrieb. Schweizerische Zeitschrift für Forstwesen. January, 1906, pp. 353-358.

Influence of Wind on Tree Growth.

A well illustrated article by Emeis, a continuation of a series on the unfavorable influences of wind on soil culture discusses the effects on tree growth by reference to the scrub forests (Krattbusch) in Schleswig-Holstein on the Jutland peninsula. Here the forests situated on the high plateau exposed to the westerly sea winds fall off in their height until the front does not attain more than meter height, while those on the East side grow up normally. The plantations made on the windward side of the islands in the Baltic sea show the crowns of the broadleaf species cut as with shears.

The oak furnishes the best objects for study of effect and possible remedy of the damage, since it grows on any soil and, due to its deep root system, persists even if the superior part is maltreated.

This species grows on the loamy soil of the East side of Schleswig to giant trees, on the sandy plateau exposed to the winds being reduced to a mere shrub, the trunks growing zig-zag fashion, for in the lower part creeping horizontally along the ground then perhaps erecting at right angles; the branches repeating the zig-zag form. Such a shrub cut down to the base repeated the same form and in 20 years formed a prostrate rosette of one-half meter high and 4 meter diameter. This is due to the loss of endbuds in winter, and the late budding in spring preventing a ripening of the wood, and loss of branch tips in the early winter by frost, or drouth induced by rapid transpiration under the influence of the winds and the rapid changes of temperature with land and sea winds. It is only the buds and shoots near the ground under protection that can develop for a time normally. Most curious forms are the result.

Beech, which occurs more rarely, behaves similarly; the rarity of seed years, every 20 or 30 years, and lack of sprouting capacity is the reason for its comparative rarity as compared with the oak, which seeds early and frequently, and as far as sprouting is concerned, seems indestructible.

Under these wind conditions even the frugal Scotch pine does not thrive. All conifers in this province are introduced, the first plantation having been made about 1595. These have developed well except where exposed to the seawinds. In the 18th century it was planned to establish protective forest belts on the extensive heaths and without taking into account the climatic conditions Scotch pine was sown. Little of these plantings has remained except here and there a specimen between birch and spruce which were later introduced. The "desert climate" of the open country with its extreme frosts, mists, cold and wind, killed the young plantations, especially where bog-iron ore still further delayed their development. Only in the protection of native oak and beech forest or of elevations of the ground were they successful.

Finally, in the last half of the last century, *Pinus montana* was introduced and proved a perfect success as a protective species. Later, especially on the turfy heath soil, *Pinus Murrayana* was successfully tried, which grows more rapidly and with a single stem, and so far has shown itself hardy in the wind.

With the protection of these conifers, planted into the scrubby oak forest, it is possible to bring by proper thinning even the oaks into proper form, as shown in one of the illustrations.

Ungünstige Einflusse von Wind und Freilage auf die Bodenkultur. Allgemeine Forst-und Jagdzeitung. January, 1907, pp. 1-5.

Selection Coppice.

A little known method of management in coppice (taillis furetés) is practiced in certain parts of France and Switzerland, a full description of which with results by Badoux is found in *Journal forestier suisse*, 1906. Through conversion into timber forest the area of selection coppice, hardly over 50,000 acres, is gradually reduced, yet the method may well be applicable to farm wood lots, where fuel production is the main object. The main feature is of course a diameter limit, which is placed at 4 to 5 inches, the return time being mostly 10, up to 20

years. It is practiced specially on steep slopes with rocky or at least shallow soil, largely composed of beech, with ash, maple, basswood, oak, etc. Where spruce and fir come in, they are removed to protect the coppice. Besides the sprouts of proper diameter, damaged and poorly growing sprouts and those overshadowing seedlings are taken out.

The regeneration is excellent and rarely requires artificial aid. The resulting fuel wood is excellent, and there being a good local market the money returns are satisfactory.

A particular case, that of the commune of Veytaux, is reported in detail, their woods, now over 300 acres, having been well managed since before the year 1759. The woods are situated on the limestone rocks and chalk of the Jura mountains from 1,200 to 3,500 feet on rocky steep, North and East slopes, of 77 to 79% inclination, the wood being shot down into the valley on ground slides.

The yield during the last 25 years averaged about ½ cord of timber wood equal to nearly 45 cubic feet and 90 faggots of brushwood, equal to 22 cubic feet solid or altogether 67 cubic feet of wood per acre and year, which by deducting 5 per cent. for waste land may be raised to 70 cubic feet, somewhat more than beech timber forest might yield on the same site.

The gross money returns were slightly over $6 per acre and year and, allowing administration cost of 14 cents per acre, the net yield $3.50. Comparing this with timber forest results in the neighborhood, it is found to exceed these by from 35 cents to $1.00, and this in spite of the fact that there has been hardly any rise in prices for the coppice material while the net price of conifer workwood rose from 6 cents per cubic foot in 1881 to 10 cents in 1905.

Der Ertrag der Gefemelten Niederwaldungen im Forstkreise Vivis. Schweizerische Zeitschrift für Forstwesen. December, 1906, pp. 358-365.

Efficient Spark Arrester.

A new spark arrester has been adopted by the Quebec and Lake St. John Railroad, which is recommended by the Department of Lands and Forests of the Province of Quebec. It is constructed upon an entirely new idea and is quite a decided step in advance of anything heretofore tried. In brief, the device consists of a circular hood of wire spark cloth attached

a few feet above the rim of the stack, which serves to arrest and reflect the cinders downward either into the stack again or into a wire basket clamped around the stack, its upper edge being flush with the rim of the stack; if the former, the operation is repeated until ultimately the cinders fall into the basket and work their way through the mesh and to the ground. During the season of 1906 which was one of the driest ever known, no forest fires occurred along the railroad, while in former years there has always been a heavy loss from this source. The device is the invention of Mr. W. C. J. Hall, Superintendent of the Forest Protection Service of the Province of Quebec.

The Canada Lumberman, December, 1906.

MENSURATION AND FINANCE.

Financial Comparison of Species.

The choice of species on which to base forest management is one of the most important, for it influences not only the yield but the preservation, improvement or deterioration of the soil. In discussing carefully the results of forest management in the Alsatian State forests during 23 years, Oberforstmeister Pilz formulates as the proper aim of forest management "the continuous growing of marketable valuable material, workwood especially, under continuous care of soil vigor and with an interest rate on the capital involved in the management commensurate with the condition of the property."

Hence judgment of the marketableness and financial effect of the species is most essential. Marketableness depends in the first place on technical qualities, hence species producing a large workwood per cent. and such as have an established world market, like oak, will on suitable sites be always profitable. Next the quantity in demand is to be considered, and in this respect the conifers stand foremost. Lastly the financial productive capacity should be studied. A judgment regarding this capacity can only be had through study over large districts and long periods. *Nothing is more dangerous in forestry, than to*

draw conclusions from limited results, especially as regards choice of species.

The author then brings forward the data of results secured on about 125,000 acres for the years 1882 to 1904, applying to five management classes, namely fir forests, beech forests, fir and beech mixed, pine-oak-beech type, and oak forest. Of course, none of the districts denoted by one species are really pure. After careful analysis and allowances for local conditions, difference of rotations, etc., which might vitiate comparableness, the following results appear to have been attained:

Annual Yield per Year and Hectar.

Type	Total wood fm p. ha.*	Timber wood fm p. ha.*	Money Mark p. ha.*
Fir Forest	7.13	6.76	76.90
Beech Forest	3.89	3.19	34.75
Fir-Beech	5.22	4.56	57.50
Pine-Oak-Beech	4.22	3.19	49.06
Oak Forest	6.56	5.02	101.

*To translate into cu. ft. per acre, multiply by 14.1; into dollars per acre (approximately), divide by 10.

The fir forest then produces more than double in quantity of the beech forest, and in money returns the difference is still larger, while the oak forest with a smaller production yields 20 per cent. more than the fir forest.

Comparing the results of the management with normal yield tables the following relations develop, setting the production of fir equal to 1.

	Fir	*Beech*	*Oak*	*Mixed*
Yield Table	1	.65	.70	.61
Actual results	1	.65	1.10	.70

This comparison shows only an essential difference in the oak forest, which is explained by the statement that the area was small (500 acres) and of specially good quality. The author adds that there is no doubt that "our forests will in future produce better not only qualitatively but quantitatively. The growing young stands at least promise in regard to full stands, work wood and mass production more than the old timber, for these have grown mostly according to the free will of nature."

While in strictly comparable forest of fir and beech, on same sites, with same rotation, method of management, and same

market conditions the former produced 77% more workwood, and 86% more money returns, the author "would never think of recommending everywhere to replace beech by fir, for besides the financial productivity the question of the rotation needs further scrutiny and the influence on soil needs to be considered." But the growing of pure beech forest he decries as a managerial error, recommending the beech merely as an underwood and nurse.

Referring to the further consideration of financial result according to the soil rent theory briefly, the author claims, that by using correct values for soil and stock it could be shown that fir forest produces nearly double the interest rate on the forest capital that the beech forest does.

Leistungen der Hauptholzarten in einigen unterelsassischen Staatsforsten nach Zuwachs und Geldertrag auf Grund der Wirtschaftsergebnisse aus 23 Jahren. Allgemeine Forst-und Jagd-Zeitung, November, 1906, pp. 361-370.

Yield of Black Locust.

Black Locust has been planted in Europe quite extensively, and especially in Hungary (See Article in vol. IV). The following material and financial results are reported from Switzerland the wood being used for wagon work, vinyard stakes and fuel.

A 15 year old stand, 1.6 acres, the stoutest trees being 6 inches on the stump, produced 2,083 cubic feet or 1,300 cu. feet per acre, and nearly 90 cubic feet per year. With a cost of $30 for the wood chopper the net result was $310, or nearly $200 per acre and the net yield after deducting costs, taxes, etc., was $10.85 per year.

A 45 to 50 year old stand of $\frac{3}{4}$ acre, the stoutest trees being 14 inches on the stump 2,728 cubic feet per acre and 54 cubic feet per year. With about the same price per cubic foot, namely 15 cents, the result per acre was nearly $420, the net yield per year $5.67.

A third cut of half an acre of the same age yielded 71 cubic feet per acre and year and $7.24 in money results. Altogether a good showing.

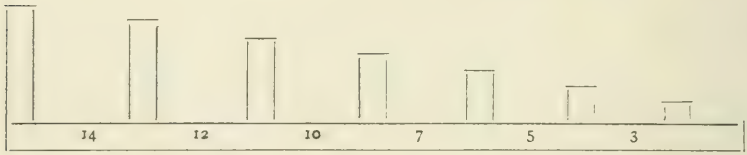
Material-und Gelderträge der Akazie. Schweizerische Zeitung für Forstwesen. January, 1907, pp. 23, 24.

A new Caliper.

For use, where small posts or poles are to be assorted according to prescribed dimensions, the work can be expedited by constructing a caliper which contains the various dimensions, say varying by two inches, permanently set. This may be constructed by fastening to a handled caliper stick short arms or processes at the varying distances, inscribing on the stick the number of inches corresponding to the distance between the arms. The height of the arms varies naturally, each being about one-half of the size to be measured.

It would appear that this simple, easily carried tool might do good service for rapid size classification in forest surveys of young growths.

The tool, designed by Dr. Gehrhardt is sold by Wilhelm Göhler's Wittwe at Freiburg, Saxony, for 2 Mark. Schematically the tool has about the following figure:



Eine neue einfache Kluppe zur Stärkensortirung der Stangen. Allgemeine Forst-und Jagdzeitung, November, 1906, p. 395.

UTILIZATION, MARKET AND TECHNOLOGY.

Railroad Ties of Quebracho.

The wood industry of Argentine has until lately been so little developed that even where native woods would have been superior, importations were used. Lately there has developed considerable activity, especially in exploiting the Quebracho forests both for tan extract and wood, which is specially fit for water construction and railroad ties. In the latter use it has largely replaced the steel ties, owing largely to a law which made the use of Quebracho ties in new concessions obligatory. The opening up of the Quebracho forests in the province of Chaco gave the incentive to

this law. Several corporations (some 29) were formed to exploit this forest, either buying or renting lands from the government, some 8 to 9 million acres being invaded. One of these is planning to cut 7,000 ties per day. Yet there is difficulty to supply the suddenly increased demand for home need in new construction which is extravagantly estimated at over 5 million ties.

Voices are heard against the probable ruthless exploitation which is likely to result.

Quebracho grows very slowly and cattle like to feed on it, two disadvantages from the standpoint of reproduction. Railroad ties in Buenos Ayres cost about $2, on the interior railroads from $1.50 to $1.75, while steel ties (pot pattern) cost only $2 at seaports, so that according to location the relative cheapness of the steel tie may still be considered as favorable. German capital seems most prominent in these developments.

Verwendung von Quebrachoschwellen, etc. Allgemeine Forst-und Jagdzeitung. January, 1907, p. 37.

Notes on Railroad Ties.

In a recent circular letter issued by the United States Steel Corporation the prediction is made that the next great impetus to the steel industry will be the general introduction of steel ties. Already, it declares, as the result of an experimental track laid in 1904, the Bessemer and Lake Erie Railroad Company is installing 105,000 steel ties covering 42 miles of road. In addition experiments are being made by ten other railroad companies.

In connection with the above it is interesting to read the following taken from the Southern Lumberman. "It seems that the civil engineers of the railroads are seriously considering the adoption of new dimensions for cross-ties; in fact are giving this subject more attention than that of finding a substitute for the wooden tie. In regard to the latter, it is said steel and iron ties have been experimented with, but it has been found that they do not last as long as either yellow pine or oak and are not by any means as satisfactory. The sulphur in the bituminous coal smoke injures the tie and exposure to water causes rust. A committee has recommended that for high speed tracks a tie 10 feet long and from 8 to 10 inches wide be used. The regular

tie, it is contended, does not give sufficient base to the rail and being too short, allows the weight to lower on one end more than on the other."

In a statement issued by the tie and timber department of the Atchison, Topeka and Santa Fe Railroad in regard to the life of the treated tie, it appears that during the period between 1885 and 1905, over thirteen million treated ties were put in the track of that system east of Albuquerque, New Mexico. The records of removals date back only to 1897 and show the average age of those taken out since that time to be 10.6 years. Of those put down in the year 1897, 84.95% are still in service. It appears furthermore that the life of the treated tie showed great variation in different parts of the country, due to different soil and moisture conditions. For instance, the average life in Missouri was only 4.5 years while that in the Rio Grande Division was 14.4 years. The process employed from 1885 to 1890 was the Wellhouse (Chlorzinc with glue and tannin), from 1890 to March, 1906, burnettizing (Chlorzinc) was employed, and since then creosoting has been tried.

Meanwhile several railroad companies have begun planting to supply their needs of ties. According to the Railroad Gazette, the Pennsylvania Railroad has planted 1,278,000 Yellow Locust trees during the past five years; the Michigan Central R. R. 80,000 Catalpa; the Illinois Central R. R. two large groves of Catalpa, one in Illinois and the other in Louisiana, and the Norfolk and Western R. R. a grove of six acres in Virginia. [See article on Railroad planting in this issue.]

Who would expect to read of an American railroad buying ties in Japan? It is reported, however, that the Southern Pacific has let a contract for 1,500,000 oak ties from Japan to be delivered at Quaymas, a port on the Pacific coast of Mexico, for 56¢ gold per tie.

In regard to competition with Japan for railroad ties, the tie producers along the Pacific coast say they do not fear the competition, as it is claimed by them that Japan oak has been proven to be of little durability. [There is no good reason for this belief. ED.]

St. Louis Lumberman, July, 1906.

Uses of Wood.

In answer to inquiries as to new uses for balsam, poplar and spruce, propounded by the Canada Lumberman to several members of the trade, the majority replied that, (1) balsam would not make good shingles or weather-boarding as it would warp and rot too readily; (2) that spruce, poplar and balsam would make fairly good lath, but of course not as good as white pine.

The Canada Lumberman, November, 1906.

Experiments are being conducted by millmen in California to determine whether the wood of the tanbark oak, *Quercus densiflora*, can be utilized. At present it is left to decay in the woods after the bark is removed. If properly seasoned it is claimed that it is as serviceable as hickory.

Pacific Coast Wood and Iron, November, 1906.

Turpentine from Pulpwood.

The New York Lumber Trade Journal, January 1, 1907, is the authority for the statement that a Maine pulp manufacturer has succeeded in extracting turpentine as a by-product from the manufacture of wood pulp, thus creating an annual saving to the plant of $15,000.

Scarcity of Hickory.

At a meeting of Hickory consumers held last summer the question of the future supply of hickory was thoroughly discussed. When it is considered that 250 million feet is used annually by vehicle and implement manufacturers, it is not surprising that the rapidly increasing scarcity of such stock is giving those manufacturers great concern. It seemed to be the general opinion that whereas no substitute could be found, the only thing to do was to go into the business of raising hickory. Members of the Forest Service advised the growing of hickory by the coppice system in wood lots. A committee was appointed to consider the idea, and it seems likely that some definite work along this line will be taken up by the individual companies.

Southern Lumberman, 1906.

Apple Wood.

The Apple tree is not generally thought of as a source of lumber, but recently there was stacked up in front of the depot at Hartford, Michigan, 100,000 feet of apple wood, awaiting shipment to the Atkin's Saw Company, to be used for saw handles. The wood is hard, tough and without much grain, and when made into handles never splits or shreds. The lumber is all in short boards, for very seldom are any boards over six or eight feet long obtainable.

Southern Lumberman, July 25, 1906.

Modern Milling and Logging.

As an indication of the tremendous output of a modern sawmill, the news that a company has recently been formed in Louisiana to erect what will be the largest mill in the world with an annual capacity of 150,000,000 feet, or 600,000 feet a day, is of considerable interest. It is reported that the syndicate has acquired about a million acres of timber lands in Louisiana and Mississippi, that it will build a railroad to tap this country and that a new town will be formed at the site of the mill. The mill will be of steel and concrete construction and the contracts which have already been let, call for an expenditure of $1,500,000. This is to include the cost of the houses also. It is expected that the plant will be in operation by March 1907. New Orleans will be the chief point of shipment for the product of this huge mill.

Southern Lumberman.

Logging by Electricity.

In Washington the first electric logging engine on the Pacific coast has been installed. Power is transmitted from a power company's line a distance of 7,000 feet to where the logging is going on. Two donkey engines have been fitted up with electric motors, and the lumbermen claim that the use of electric power has proved cheap, convenient and entirely satisfactory in every way.

The Canada Lumberman, August, 1906.

Modern lumber methods are again illustrated in the monster lumber raft which was recently towed from the Columbia River

to San Francisco. It was cigar-shaped, 725 ft. long, 55 ft. beam, 22 ft. deep and contained 9,000,000 bd. ft. The voyage required 6 days.

The Pacific Coast Wood and Iron.

STATISTICS AND HISTORY.

Forestry Exposition of Bavaria.

In connection with a general industrial exposition of the Kingdom of Bavaria at Nuremberg in 1906, the State Forest Administration made in a separate building one of the most comprehensive exhibits of the field of forestry ever made anywhere, this being perhaps the most notable feature of the exposition.

From the very complete account of the details of this many-sided exhibit, we may only abstract some of the statistics of Bavarian forestry conditions which were elaborately exhibited in charts.

The total forest area is 6,464,000 acres, of which over one-third is State property. Municipalities and institutes own 970,000 acres which property in 1901 was valued at over $40,000,000. This leaves in private ownership nearly 50 per cent. of the forest area. In Lower Bavaria this class of ownership rises to 79 per cent. of the county forest area. It originated in the first decades of the 19th century through partition of old mark or communal forests, much depreciated by servitudes. Here the State offers plant material at low cost, the use of which in the last decade has increased from 4.5 to 18.5 million. On the State property servitudes still require annually material valued at round $700,000.

Due to the notorious damage by the pine moth in the Nuremberg forest in 1894-7, over 30 per cent. of the area had to be cut, the age classes from 20 to 60 years suffering the most, with over 50 million cubic feet. The still more notorious damage of the Nun, which devastated Bavarian spruce forests in 1837-40, and again in 1890, as well as other insect pests were graphically exhibited.

The damage by factory fumes on a pine forest during 20 years was shown in the increment by comparison of affected and unaffected areas, the differences being—

	Damaged	Undamaged
Annual radial increment to the 53d year	2 mm	2 mm
from 53-63 "	1.5 mm	2.7 mm
from 64-73 "	.7 mm	2.1 mm

The influence of removal of litter was shown in a given locality as—

	With	Without removal
Yield of an 80 year spruce forest per ha.	*235 fm*	*735 fm*
Money value	*2625 Mk*	*9175 Mk*

The price movement for oak in the Spessart was shown as follows for logs, the classes being size classes rather than quality classes—

	1885	1905
I class,	44.17	153.26
II-IV class,	32.07	89.35
V-VIII class,	26.70	39.31

Interesting growth tables were also exhibited.

Die Ausstellung der Staatsforstverwaltung, etc. Allgemeine Forst-und Jagdzeitung, December, 1906, pp. 419-429.

Forests of Saxony.

The Saxon forests are among the most profitable of Germany. From Dr. Mammen's volume of 320 pages, describing their condition and management the following statistics appear.

The forest area of the Kingdom is 950,000 acres, or 25.8 per cent. of the land area. Of this 45.2% is State forest, 6% communal, 2.8% institute forest, and 46% owned privately, of which 9.4% under government control.

Nearly 89 per cent. of the area is stocked with conifers against 68% for all Germany, spruce forest with 58.2% being in the lead. This accounts for the high yield which in 1900 was 67.7 cubic feet per acre as against 49.3 cubic feet for all Germany. The workwood per cent. is especially high with 71.5.

Die Waldungen des Königreichs Sachsen. Allgemeine Forst-und Jagdzeitung. November, 1906, p. 378.

Timber Supply of Great Britain.

In a letter to Mr. E. Stewart, Dominion Superintendent of Forestry, Sir Dietrich Brandis, the father of the present system of forestry in India, says:

"I cannot sufficiently urge upon you the necessity of concentrating all your energies upon one point, that is, the constitution of as large an area of State Forests as possible, to enable Canada (I mean the Dominion) to supply the greater portion of the coniferous timber now imported into Great Britain, permanently.

"The timber now imported into Great Britain annually amounts to over nine million tons, valued at £24,000,000; and the greater part of this is coniferous timber. Of this quantity

Sweden and Norway supply	5 million tons.
Russia supplies	2 " "
Dominion of Canada supplies	2 " "
	9 " "

Russia, as soon as the present troubles have been overcome, will develop its trade and industries in a manner not anticipated at present, and the result will be that they will consume all the timber this country can produce. Germany formerly was a timber exporting country and it now imports five million tons a year. And this, though the area of productive forests has been steadily increasing, and the annual yield per acre is now much larger than it was thirty years ago.

Sweden and Norway, tempted by the high prices and the ready market in England, are cutting more than their forests annually produce. At the same time industry and manufactures are increasing and the result will be that that source also will come to an end.

"The United States exports very little to England now, and the Dominion of Canada is the only country from which, if the forests are properly managed, a permanent supply of coniferous timber for Great Britain can be expected."

The inevitable result of these conditions will be a steady rise of prices, and ultimately a very considerable income for the Government. The necessity is urged of getting under management

as large an area as possible of State forests. The exploration of the northern wilderness region is particularly urged, for the reservation of lands from settlement at the sources of the great rivers. The writer states that Great Britain is compelled to import large amounts of timber instead of herself producing them, because the land is nearly all private property and as a rule the great proprietors are too rich to feel the necessity of increasing their incomes by making the forests pay.

Views of a Distinguished Forester. Canadian Forestry Journal. December, 1906. Pp. 210-212.

Lumber Cut in Various Regions.

As indicative of the waning timber supply of the upper lakes district, it is stated that mills in the neighborhood of Duluth, Minn., with a yearly production of 210 million feet will go out of commission January 1, 1907. If to this there is added the advance sales by this field of 118 million feet for 1907 delivery, the grand total of 328 million feet represents just so much less stock available for the trade during 1907 that this time a year ago.—New York Lumber Trade Journal, December 1, 1906.

While the Forest Service statistics show that the total lumber cut of the State of Michigan fell from third place in 1904 to fifth place in 1905, yet certain sections of the State seem to be holding their own and even show an increase. This is true of the Saginaw Valley district. The output for 1906 was 114.8 million feet, an increase over that of 7 million, or equal to 6½%.—New York Lumber Trade Journal, February 1, 1907.

According to the report of the Secretary of the Yellow Pine Manufacturers' Association, held in January, the total cut of yellow pine for the year 1906 is estimated at 9.6 billion feet. This shows an increased cut of 1.4 billion feet, equal to 17 per cent. over that of 1905. These figures are believed to be conservative, but will be verified as the reports of actual output of each mill are received.

Ever since the big hurricane of last fall in which it was estimated $10,000,000 worth of timber had been blown down in the turpentine properties in Louisiana, Mississippi and Alabama, the timber men have been making strenuous efforts to haul, saw, or rush the logs into the nearest ponds and creeks in order to

prevent their final destruction in April or May, when the worms will appear.—Southern Lumberman, November, 1906; January, 1907.

That the West is rapidly forging to the front rank in lumber production, and that the State of Washington intends to keep at the head of the list where the cut of 1905 placed it, appears certain, when it is seen that the shipments of lumber for the first six months of 1906 were 30% in excess of those during the same period in 1905.—New York Lumber Trade Journal, September 15, 1906.

Redwood production in California is still maintaining the steady increase which it has shown during the past fifteen years. The cut for 1906 was 409.7 million feet, which was an increase of 52 million or 14½ per cent. over that of 1905.—American Lumberman, January 26, 1907.

The mischief which may be bred by statistics unless properly interpreted is pointed out by referring to the Census Bureau Bulletin 57, which brings statistics for the year 1904 of the lumber industry among others. By change in method of statement it would appear that the cost of logs was less in 1904 than in 1900, as determined by the Census. This apparent absurdity is due to the fact that quite properly the value of lumber remanufactured in planing mills was taken out of the cost of materials for 1904, but the same deduction was not made in the figures for 1900. As a matter of fact cost of materials in the five years increased 25.3 per cent., value of products 26.1 per cent., wages 23.7 per cent., salaries 59 per cent., miscellaneous expenses 106.3 per cent.—American Lumberman, February, 1907.

Stumpage Prices.

The question whether high lumber prices are due to increased price of stumpage, is answered by reference to the change of price for particular tracts. Six years ago a tract of hardwood timber in Wisconsin was sold for $1.00 an acre. Two years later it was bought for $2.00 and then sold for $5.00. This past year it was bought by the Whiteman Lumber Company at a price averaging $20.00 per acre.

Stumpage in the South also continues to increase in price. Recent sale of 560 acres in southeastern Mississippi brought the

record price of $57.00 per acre; another tract brought $44.00 per acre and several sales are reported at $25.00 an acre. Fifteen years ago any quantity could be had at from $1.00 to $6.00 per acre.—The New York Lumber Trade Journal, 1906.

Rise of Prices.

The price of Spanish cedar from both Cuba and Mexico, from which cigar boxes are made has gone up 80 per cent. This is due, it is said, not so much to a scarcity of material as to the inaccessibility of the timber, that near the coast having been used up.—The Barrel and Box, December, 1906.

The Hardwood Manufacturers' Association reports increases in all hardwood staples. Poplar lumber has lately increased $1 on most sizes and from $2 to $5 on wide stock; plain and quartered oak has also increased $1 to $50 per M. for firsts and seconds, and to $71 for quartered stock; ash has increased from $3 to $5 according to size and quality; cottonwood for wide stock is $4 to $9 higher, and gum is 50 cents to $1.50 advanced.—American Lumberman, February, 1907.

Prices are also rising in Germany, especially oak is advancing, the lowest price at Nürnberg being over 20 cents per cubic foot, the highest over 40 cents, while pine and spruce are between 6 and 10 cents per cubic foot.—American Lumberman, 1907.

POLITICS AND LEGISLATION.

Taxation of Forests.

In connection with the discussion of the necessity of changing the methods of taxing woodlands in this country, it may be of interest to review the new general tax law of Wurttemberg in operation since 1905.

An income tax forms the principal State tax, other modes of assessing taxes being employed only in a minor degree. Both income tax and realty tax is assessed by State and municipality (county or community) against forest property. For State purposes the income is the net yield of the entire forest manage-

ment. The income is the actual sale results, cash or credit, of the regular cut, principal and intermediary, as well as the domestic consumption of the owner at local average prices. Extraordinary cuts are taxed in their results if they were made to secure cash or to change the use of the cut area; if occasioned by natural disaster, like windfall, snow breakage, insects, etc., the results are not considered as taxable income, for this enforced cut is considered against the interests of the owner, disturbing his management.

As expenses are considered the actual cost of the management, cost of administration, protection, cultures, woodchoppers' wages, insurance, road building, houses, etc., and also bad debts of former years, if they had then been figured as incomes, costs occasioned by extraordinary cuts, including those for reforestation do not figure any more than the incomes from such untimely utilization.

This method of arriving at the income is the same as practiced in Prussia, and, while especially in intermittent management it has the disadvantage of unevenness from year to year, it is found preferable to the Austrian arrangement, which is based upon the average annual increment and sustained yield management, a fiction.

The tax rate is determined every two years, the law, however, states the normal rate, which varies from 2 mark on an income of 500 to 650 mark to 5 mark on an income of 200,000 mark or more.

Besides the income tax, the hitherto customary realty tax is continued at a reduced rate. It is based on the net yield (not income) determined by a commission of experts, the said being ranged in site classes and the yield per acre determined for each class. The determination of values (Katastrierung) was made during the years 1875-1887. The gross yield was determined under a suppositive management usual under conditions at the time, and the costs under the same supposition were deducted to secure the net yield per unit area of each site class, the taxable value being found by multiplying by the areas involved in each case. This assessment of the "tax capital," which does not consider individual conditions and special methods of management is supposed to be good for a long period and is only revised if

changes in use and in property conditions arise. For the year 1906-7 the realty tax was placed at 2 per cent. of the tax capital. Before the introduction of the income tax it was 3.9 per cent.

The communal expenses, as far as they are not covered by income from municipal properties are met by distributing them among the property owners according to the recorded tax capital.

Die Neuordnung des direkten Steuerwesens. Allgemeine Forst-und Jagdzeitung, December, 1906, pp. 417-419.

Encouragement of Private Forestry.

It is significant that the subject of private forestry is again and again ventilated in meetings of German foresters. These discussions are interesting to us as they indicate how much reliance in general may be placed on private forestry, and in what way it fails in a country where conservative ideas are more natural than with us.

A speaker at the meeting of Silesian foresters, v. Salisch, a noted private forest owner, points out that "notoriously the majority of the medium-sized and small private forests and quite a number of larger ones are managed in a very unsatisfactory manner, whereby the national wealth is heavily damaged." This is the reason, he declares, why Germany does not produce all its wood requirements, and must import. Besides deficient regeneration and care, removal of litter, etc., low rotations are the cause of this condition.

The coercion of small owners to combine into forest associations, such as the law of 1875 provides as voluntary, is advocated, when on the connected forest properties professional foresters might be employed with profit. The State assists private owners to a considerable degree with funds, but with little effect, since on the many small areas supervision in the use of the funds becomes impracticable.

The successful result of forest association in the district of Stade is pointed out, where some 15,000 acres have been brought under a uniform working plan, each owner being obligated to manage accordingly. Increased freedom for State foresters to assist in the management of private properties, a bureau of working plans for private forests, and supervision of the same, special courses for private owners at the forest schools, and forest nur-

series from which private owners may supply themselves at near cost price, are among the measures advocated to encourage private forestry.

Versammlungen Norddeutscher Forstvereine. Allgemeine Forst-und Jagdzeitung. November, 1906, pp. 390, 391.

Forest Politics in Switzerland.

One of the most far-sighted laws embodying the modern forest policy of Switzerland was enacted in 1902, especially reorganizing the forest police, enlarging the sphere of State interference, increasing protective forest areas and surveillance of private management. Since, however, the execution is left to the different cantons, the practice has still remained largely undeveloped and is by no means uniform, hence propositions for the methods of carrying the law into execution are still being ventilated.

There are two classes of forest involved, namely municipal or corporation forests and private forests which have been declared protection forests.

The former are managed according to sanctioned working plans, but the execution of the plans, especially the important marking of trees is not always, as it should be, done by a technically educated forester.

In private protection forests all considerable cutting and especially clearing requires sanction of the cantonal authorities.

It seems still doubtful which officials should exercise the supervision, but it should naturally be in the hands of the forest administration. The permission to cut should only be given after examination of the premises, and according to local conditions only under reservations as to the quantity, or number of trees, marking by foresters, and employment of experienced woodchoppers, measures to protect young growth, planting of cut areas, corrective works in water channels, exclusion of cattle, setting of a time for finishing the cut or performing cultures, etc. Inspections during the progress of cuttings are essential to insure obedience to the conditions. As to the interpretation of various details of the law there appear to be still wide differences

of opinion, especially as to the permission of clearings and the amount which may be cut without permission.

Wie ist in den Gemeinde und Korporationswaldungen die Schlaganzeichnung und in den Privatwaldungen die Holznutzung von Staates wegen zu ordnen? Schweizerische Zeitschrift für Forstwesen. November, 1906, pp. 329-334.

MISCELLANEOUS.

Mistaken Nomenclature.

In a suit recently decided in Tennessee, the court held that 'overcup' or 'burr oak' is not "white oak" in the ordinary meaning of the word "and that the defendants had no right to the 'burr' or 'overcup' oak on a certain tract when their contract specified 'white oak.'" According to the wording of the question, the decision is correct, but a jury of timber experts would certainly decide that the overcup or burr oak is of the same variety of oak as the white oak, the difference lying more in the leaves and acorns than in the wood.

Climbing Apparatus.

Prof. Friedrich, well-known for his ingenious devices—we recall the increment autograph referred to on page 52, vol. IV—has designed a climbing apparatus (he calls it a "grimpeur," from the French), which permits the climbing of trees, masts, poles without the injury which climbing irons occasion. It consists of two short ladders, each hung to a steel plate to which is fastened a spring steel band which can be thrown around the bole of the tree and then be tightened by an appropriate ratchet work so that the ladder can be fastened to boles of any thickness. One ladder being fastened to the tree, the other may be fastened higher up, the first then to be unfastened and attached above the second and so on, the apparatus being so constructed as to permit this movement readily.

Steigapparat. Centralblatt für das gesammte Forstwesen. November, 1906, pp. 449-459.

NEWS AND NOTES.

E. A. Sterling, *In Charge.*

The reports on the free use business in the Forest Reserves for the past year show in round numbers that $75,000 worth of material was given away to 15,000 applicants. By far the greater part of this was inferior material such as cordwood, poles and posts. Saw timber formed an insignificant part. The total amount granted on a single reserve varies from $4,000 to $5 with an average of about $800. The reserves in Colorado, Utah and southern Idaho did the greatest amount of free use business, while those in western Oregon and Washington did the least. The work has taken an undue share of the rangers' time because the demands of the applicants have been very exacting and the handling of the permits has not been systematized. Several of the Supervisors speak of it as the hardest problem they have to deal with. In the future the handling of free use permits will have to be more methodical, and more pains should be taken to see that the applicants improve the condition of the forest by cleaning out dead timber and suppressed and diseased trees.

The Forest Service has recently secured several Assistant Lumbermen. They will be assigned to reserves where there are timber sales large enough to make the services of a woods foreman of value. They will be charged with the duty of instructing rangers in scaling, and of protecting the interests of the Government in the sale and cutting of timber.

The co-operative work which the Forest Service has been carrying on with the State of California since July 1, 1903, will be brought to a close this coming spring. It is by far the most extensive work of the kind ever attempted and will probably result in a more detailed knowledge of forest conditions in California than has been compiled for any State. The prime object was to determine a State forest policy. As a basis for this the questions of forest distribution, extension, fires, chaparral, lumbering, etc., were carefully studied. A policy was outlined two years ago and a State Forester appointed. The remaining re-

ports are being compiled for publication and will contain data not only of value to the State Forester, but to the general profession as well. The results have already been very encouraging and with the proposed changes in the laws which it is hoped to make during the present session of the Legislature much more effective work should be done in the future. A special study of sugar and yellow pine of the State has already been published as a Service Bulletin. Reports on Lumbering and Market Study in the Red Fir Region, Forest Conditions in the Sierras, McCloud Working Plan, Eucalyptus, Forest Planting in Agricultural Regions, and possibly a Commercial Tree Study of White Fir will be published. Many general reports and miscellaneous papers have also been sent to the State covering such subjects as forest distribution, grazing, chaparral, forest fires, State lands and forest conditions in Southern California and in the Redwood Belt.

It is an encouraging condition which is leading trained men to go into private work as consulting foresters. It has long been preached that commercial organizations would eventually need the services of such men and that this time is slowly arriving becomes more and more apparent. One of the recent steps in this direction has been the opening of an office of consulting and contracting foresters in Baltimore by A. K. Chittenden and A. P. Patterson, formerly of the Forest Service. Both men have had thorough training and a wide field of experience in government work which fits them for the management of timberlands in all regions. Their attractive prospectus, under the heading of "Management of Forest Lands," indicates that they are prepared to take up any line of work, and they offer to give special attention to such lines of work as:

"Advice on the best methods of managing forest estates, plans of management, execution and supervision of the necessary work.

"Timber estimates and forest maps, appraisement of forest lands, future or prospective values.

"Marking trees for cutting, improvement thinnings, cutting and sale of products.

"Adjustment of logging methods, stumpage sale contracts.

"Planting and nursery work."

In Canada, three lumber companies of British Columbia have secured foresters as managers, Dr. J. F. Clark, Mr. Roland D. Craig, Mr. E. Stewart, Superintendent of Forestry, having left the government service to fill these positions.

An important innovation has been made on the part of the Pennsylvania Railroad Company by engaging a professional forester to look after the woodland interests and tie interests of the Company. Mr. E. A. Sterling, well known as one of the chiefs of the Forest Service, a Cornell graduate, has been called to fill this position, with headquarters in Philadelphia.

Mr. Asa F. Williams, formerly forester of the Berlin Mills Company, in New Hampshire, has become the representative of the Lidgerwood Manufacturing Company in Atlanta, Ga., and Mr. Max Rothkugel is the forester of John Craig and Sons, at Winterburn, W. Va.

The State College of Pennsylvania proposes to inaugurate a forestry department in its school of agriculture on similar lines as the former college at Cornell University, and has called Dr. Fernow to organize the same.

The first beginning has been made with an introductory course of lectures by Dr. Fernow during the present term, some forty students attending of whom about ten intend to follow the profession. In the circular issued it is stated that twelve forestry courses are to be given, comprising not less than seventy hours, one-half of the time to be devoted to practical work.

In several of the forest reserves of the Southwest where the protection of streams supplying water for irrigation is needed first of all, the use of large sized cuttings for planting is being recommended. Many slopes are either barren, brush covered, or scantily forested and the conditions are very unfavorable for planting. The run-off into the streams is very rapid and the torrential storms usually give rise to floods which carry down large quantities of silt and gully the stream beds. Along these streams the remaining soil usually retains some moisture. The

plan is to reforest these narrow stream valleys with large sized cuttings of cottonwood, usually—*Populus angustifolia* or *P. trichocarpa.* These will help to hold the stream banks and it is hoped that the cover can be gradually extended for some distance up the slopes.

It is quite generally acknowledged that an efficient system of State fire protection should provide for paid district fire wardens, but in most States it has been impossible to secure funds for such a force. This was recommended in the forest laws for California which were presented to the Legislature in the winter of 1905, but on account of the expense it was necessary to compromise and provide only for unpaid wardens. In the revision of these laws, which is at present pending, it is hoped to come nearer the desired end by securing an appropriation for paid wardens during the summer season. This will certainly be a step in the right direction and if the plan is successful it will probably be possible later to secure appropriations for a permanent force.

That forest fires were scarce in California during the past summer is due to the efficient management of the National Forest Reserves by the Forest Service, according to the Pacific Coast Wood and Iron, October, 1906. Thus are the trade journals coming to appreciate the work of the Forest Service.

A reorganization of the inspection service of the Federal Forest Service is contemplated by which all inspectors are directly reporting to the forester through district inspectors, there being six districts into which the Forest Reserves are divided.

One of the largest pine trees cut in Minnesota is said to have scaled 7,420 feet of lumber. The tree was said to be more than 420 years old, was 126 feet high and 6 feet 4 inches across the stump. It was cut by workmen of the Swan River Logging Company working in Cass County for the Standard Lumber Company, of Dubuque, Iowa.

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THE SPROUT FORESTS OF THE HOUSATONIC VALLEY OF CONNECTICUT.

A Silvical Study.

The importance of exact methods in silvical investigations is now universally recognized by American foresters. The conditions of growth in our natural forests, as compared with conditions in the more artificial forests of Europe, are sufficiently complicated even in pure stands; while stands in mixture, and particularly broadleaf forests, offer many additional complications. Among the various classes of broadleaf forests the even-aged stands of sprout origin are in certain respects the most satisfactory objects of study. In them the interplay of natural forces is to a large degree systematized.

The second-growth forests of the Housatonic Valley of Connecticut fall within this class. To within comparatively recent years its wooded slopes supplied the charcoal and furnace wood for the iron and brass foundries of that region. In exploiting these forests the method of clear cutting was early adopted and gradually embraced practically all of the woodlands of the region. In course of time most of the young growth, like the older growth which had preceded it, fell under the axe, so that finally these forests presented the appearance of an irregular succession of even-aged blocks of various shapes and sizes, usually from fifty to several hundred acres in extent, and composed of some thirty species of the commoner northeastern trees, mainly of sprout origin, but including also occasional trees derived from seed. Some of the blocks had been cut over successively as many as five times.

With the decline of the iron industry in this part of the country, some twenty-five years ago, the forest operations were discon-

tinued. When examined for the purposes of this study, in 1901,* the forest growth included three distinct types, due to differences in soil conditions and relative position on the slopes. This study is based upon a detailed examination of selected areas within each of these types and upon comparisons of these areas with one another. To arrive at reliable conclusions in such forests, where many species are mingled together, where variation in the conditions of growth exists, and where fire, grazing, and similar interferences have added their influences, the study must necessarily enter into a large number of details. The aim has been to make the study intensive, rather than extensive. The total number of acres examined is comparatively small, but they have been chosen in such a way as to represent practically all the different conditions prevailing in the region under consideration. The various features of the problem have been studied systematically within each tract according to a carefully considered plan. It is believed that the areas examined, though limited, have been studied in such a way as to form the basis for reliable and accurate conclusions.

Forest Types.

The character of a forest, as is well known, is closely connected with the geology of the region in which it grows. The geologic forces have produced certain distinct physical conditions of rock and soil, exposure and moisture,—factors upon which distribution of trees and the expression of the forest largely depend.

The most important geologic changes in the Housatonic Valley, from the forester's point of view, were accomplished during the recent glacial age, when the surfaces of the hills were scoured by a moving ice-sheet. Upon the recession of the ice a glacial drift of boulders and till was deposited over the surface, covering the underlying formation like a continuous mantle. The main soil constituents today are sand and loam, among which are interjected layers of white clay, beds of gravel, and scattered boulders of limestone and gneiss. Here and there pure white sand was deposited and washed by the melting ice, leaving small

* The investigation was originally undertaken for the U. S. Forest Service, and is here published, for the first time, with the permission of the latter.

pockets or layers and occasionally sandy hillocks of sufficient size to support small groves of White Pine.

Such a soil is well adapted for the growth of our northeastern broadleaf trees, shrubs, and the various forms of surface growth commonly found in the leafy forests. Except along the ridges it is deep and fresh, offers no serious obstruction to the root-systems of the trees, and chemically is capable of supplying the necessary elements for all but the most exacting forest trees.

Along the lower slopes and within depressions and valleys among the hills a talus of somewhat finer material has accumulated from the steeper sides of the mountains and has enriched and deepened the original top soil. In such places, Chestnut is the dominant species, both in size and numbers. It sufficiently characterizes the forest growth to justify the distinction of a separate type as Chestnut Slope. The upper layer of soil, and especially the mold, is better in quality than that found on the higher slopes, which are steeper and somewhat opener in growth and therefore more exposed to erosion and the wind. The character of the Chestnut Slope type, which embraces about 15 per cent. of the forest areas of this region, may be seen in Pl. I, Fig. 1, and its condition is represented by the average figures in the first part of Table I. Within this type the principal associates of the Chestnut are the Red Oak, White Ash, Pignut and Bitternut Hickories, and Butternut. The Red and Hard Maple, though plentiful, are usually of small size.

As one ascends the slopes, the chestnuts diminish rapidly in numbers, although they are taller and more vigorous than on the deeper, richer soil below. On these slopes they mingle with a general assortment of oaks, hickories, maples, chestnut oaks, and other species. This type, which has been designated Mixed Slope, is on the whole less thrifty-looking than the Chestnut Slope type, the majority of the trees (except chestnut) apparently not doing so well on the less favorable soil. The Mixed Slope type comprises about 65 per cent. of the total forest area. Plate I, Fig. 3 shows its character, while the second part of Table I gives the composition of the forest and the average diameter and age.

The third type may appropriately be called Oak Ridge, since it

is confined to the tops and adjacent sides of the ridges, and is composed largely of Chestnut Oak, Red, and White Oak. The conditions of growth are very different from those of the slope types. Evidently the glacial ice-sheet did not cover these mountain tops as long and continuously as it did the lower slopes. Being of less depth, it did not erode them as much nor cover them as completely with glacial drift. In many places the underlying bed rock is still exposed. In approaching the tops of the mountains from the main slopes this bed rock is frequently encountered in the form of projecting ledges and cliffs that run along just below the ridges, with occasional breaks and interruptions, and enclose them, as it were, in a rough setting. These cliffs are the edges of synclinal, saucer-shaped folds, which interfere seriously with the drainage of the mountain tops. The soil within the Oak Ridge type is, therefore, frequently over-moist or swampy. Where the rock is exposed the soil occurs only in little hollows and among crevices and scattered boulders. It is light yellow in color and is covered with a scant, somewhat acid, poorly decomposed mold. The surface growth is largely composed of dense huckleberry bushes, grass, and patches of moss, the first two of which have such dense, fibrous root-systems that they interfere seriously with reproduction.

The result of these conditions is a stunted, scrubby forest that is opener than either the Mixed or Chestnut Slope, while the number of species is also more limited. Plate I, Fig. 2 illustrates this type, and the third part of Table I gives the average figures.

In Table I the averages for Hemlock, White Pine and Red Juniper have not been included, because these species do not sprout from the stump, are found only occasionally, and are usually of small size. Such larger white pines as once existed were long ago removed by the axe.

A glance at the table is suggestive. In passing from Chestnut Slope to Mixed Slope and thence to Oak Ridge, there is a decrease in the average number of trees per acre for Chestnut, Bitternut Hickory and Butternut. For White Ash, the maples and the birches, the largest numbers are attained on Mixed Slope and the lowest decidedly on Oak Ridge. On the other hand, there is a decided increase in Chestnut Oak in going from the slopes to the ridges. The same is true in a less degree of the three other

oaks, of Pignut, Shagbark Hickory, and of the scrubby Shadbush, which is a characteristic small tree of these stony situations.

As regards the rate of growth in diameter the two columns at the extreme right show that the Mixed Slope forest is considerably behind Chestnut Slope even with a start of four years' growth. In the Oak Ridge type a start of six to seven years is not sufficient to maintain equality in diameter growth even with the Mixed Slope; while in height growth, as previously pointed out, it falls far below both of the other types.

Reproduction in Sprout Forests.

The Relation of Sprout to Root System. As is well known, reproduction by sprouts takes place after a tree has been cut down, when new shoots are produced by the development of adventitious and dormant buds at the edge of the cut and on the sides and base of the stump, and some of these in time grow to be young trees. The stump gradually decays or is covered over by the growth of the new tree; but the root-system, or a part of it, continues to live. The period of time, however, during which the root-system preserves its vitality, depends upon the species of tree, the condition of the stump, and the nature of the soil. If the stump has been carelessly cut, or is exposed to the hot sun, or has been injured by surface fires, it will decay more rapidly and the rot may extend into some of the roots. (Pl. II, Fig. 3.) There is also an attempt at natural adjustment between the old root-system and the new sprout-growth. Where the sprouts are retarded in their development for special reasons, as, for instance, due to unfavorable situation, or to a defective stump, or to the shade of neighboring trees, a part of the root-system, being in excess of the requirements, may gradually disappear.

When the circumstances are more favorable, however, the old root-system may not only be tolerably well preserved, but itself continues to grow, producing new roots to supply the needs of the sprouts as some of the old roots decay and disappear. Moreover, if the stump is low the sprouts have a tendency to send out rootlets where they come into contact with the surface of the soil, and these may afterwards develop into substantial and independent roots. Such independent roots, it is true, may also be pro-

TABLE I.—*Average Number of Trees Per Acre, Diameter of Average Tree and Average Age, in Chestnut Slope, Mixed Slope, and Oak Ridge Types, Represented respectively by twelve, twenty-two, and ten Half-Acre Surveys.**

	Chestnut.	Chestnut Oak.	White Oak.	Red Oak.	Black Oak.	Bitternut Hickory.	Pignut Hickory.	Shagbark.	White Ash.	Hard Maple.	Red Maple.	Black Birch.	White Birch.	Paper Birch.	Yellow Birch.	Butternut.	Hop Hornbeam.	Other Species.†	Shrublike Trees.‡	Totals.	Diameter of average tree, breasthigh. Inches.	Average age, years.
CHESTNUT SLOPE																						
Sprouts,	411	22	24	46	4	19	40	8	54	61	97	7	4	2	1	27	21	18	4	870	4.1	28
Trees from seed,	3	. . .	3	4	. .	3	2	1	5	2	2	5	4	1	. .	1	4	19	. .	59	. .	. .
Totals,	414	22	27	50	4	22	42	9	59	63	99	12	8	3	1	28	25	37	4	929	. .	. .
MIXED SLOPE																						
Sprouts,	157	124	53	135	13	20	71	19	60	146	153	19	8	3	2	13	69	31	27	1123	3.3	32
Trees from seed,	3	8	4	12	1	1	4	1	9	4	3	9	7	3	3	1	10	21	1	105	. .	. .
Totals,	160	132	57	147	14	21	75	20	69	150	156	28	15	6	5	14	79	52	28	1228	. .	. .
OAK RIDGE																						
Sprouts,	29	272	99	148	45	17	201	33	15	21	72	5	2	2	. .	5	32	2	70	1070	3.2	38
Trees from seed,	. . .	14	5	12	. .	2	4	2	5	2	1	2	2	1	1	. .	1	1	3	58	. .	. .
Totals,	29	286	104	160	45	19	205	35	20	23	73	7	4	3	1	5	33	3	73	1128	.	. .

* The surveys were made by rectangular measurement, not according to "strip" method.
† Hornbeam, Beech, Largetooth Poplar, Tulip tree, Black Cherry, Basswood, White and Slippery Elm, Sassafras.
‡ Shadbush, Dogwood, Alder and Chokecherry.

duced from sprouts that originate higher up on the sides of the stump; but this will be accomplished only after the base of the sprout has extended its growth downward over the stump to the ground. (Pl. II, Fig. 4.) This usually involves a delay of years and in the meantime the balance of demand and supply between the sprouts and the roots will have been less easily maintained.

The tendency to produce an independent root-system from the base of the new sprout is more strongly developed in some species than in others. Among the trees included in this study, the Pignut and Bitternut Hickories, although they are not prolific sprouters, possess it to a remarkable degree. (Pl. II, Fig. 1.) This power is decidedly of practical value, because sound, straight, and practically normal trees are thereby more easily produced from mere stumps.

It should be noted, also, that when sprouts are sent up from large stumps they usually come from a point close to or just beneath the surface of the soil, where the bark is less coarse, and the trees that ultimately develop from such sprouts are usually straighter and have more independent root-systems than sprouts that have originated higher up from stumps of smaller trees. Few species, however, develop sprouts from stumps of these mature ages.

When the sprouts are cut at a seasonable age their stumps will in turn produce a sprout growth, and this process may be repeated as long as some part of the root-system and stump retain any vitality. (Pl. II, Fig. 2.) As stumps decay life is renewed by the formation of new roots and stems. In course of time, however, a number of factors operate against this constant process of renewal. The relation between the sprouts and the old root-system becomes more and more complicated; high or rough and misshapen stumps prevent the formation of new surface roots; the browsing of cattle, surface fires, and late spring frosts, injure the soft and tender first-year shoots, thereby producing scrubby forms. Moreover, the soil, unless exceptionally fertile, in time becomes exhausted; perhaps the rapidly growing sprouts take more from the soil than they return to it, but, above all, the frequent clearings expose it to the sun and wind and to washing rains. The resulting deterioration of the forest makes it necessary to replace a certain proportion of the sprouts by seedling

trees in each generation, and ultimately the area should be allowed to revert altogether to a seedling forest.

Development of Sprout Forests. The most satisfactory method of studying the habits and requirements of the trees that compose these forests is by a systematic comparison of each of the different species under the conditions existing within each type of forest. Such a comparative study was made in the field, and as a result average figures have been deduced for specified conditions. These results will be embodied under the following heads: the relative sprouting capacity of several of the more important species; differences in the tolerance of these species and consequent variations in form and development; preferences for particular soils and situations.

To ascertain the relative capacity for sprout reproduction in the leading species, several tracts were examined that had but very recently been cut over. Each clump of sprouts contained the stumps of one or two preceding generations, or at least traces of them. The number of live stumps in each clump, as well as the number of sprouts coming from these stumps, were counted and the results were averaged separately for each species within each of the tracts. These tracts were alike in soil and situation and were all either of the Chestnut Slope type or closely adjoining portions of the Mixed Slope type.

The resulting averages are shown in Table II. The species are arranged from left to right in the order of their capacity as sprout producers. The left-hand figures in each column represent the *average* number of sprouts per clump, while the right-hand figures represent the *average* number of stumps from which they sprouted. The three figures in italics have been placed in advance of certain others which should rightfully have preceded them in the same line, in order to preserve uniformity in the consecutive arrangement of species in columns. Where spaces have been left blank the figures have been excluded because the totals were too small to furnish reliable averages.

As regards height growth the relation for the principal species was found the same in all five tracts: Chestnut, Red Oak, Chestnut Oak, Red Maple, White Oak making the series from tallest to lowest. In Tract 4 (four years old) actual measurements make the average height for Chestnut 10 feet, for Red Oak 9

feet, for Red Maple 4 feet. Here the two Hickories exceeded the Maple by four feet, while White Ash remained shortest (3 feet).

TABLE II.—*Capacity for Sprout Reproduction of eight Leading Species as shown by Average Figures on five Tracts of Different Ages.*

Number of Tract	Age of Tract (Years)	Chestnut		Red Oak		Chestnut Oak		Red Maple		White Oak		Bitter-nut		Pignut		White Ash	
		Average Sprouts per Clump	Average Stumps per Clump	Average Sprouts per Clump	Average Stumps per Clump	Average Sprouts per Clump	Average Stumps per Clump	Average Sprouts per Clump	Average Stumps per Clump	Average Sprouts per Clump	Average Stumps per Clump	Average Sprouts per Clump	Average Stumps per Clump	Average Sprouts per Clump	Average Stumps per Clump	Average Sprouts per Clump	Average Stumps per Clump
1	1	60	7	**22**	2			50	5								
2	2	50	3	25		28	3	**14**	2	17	2						
3	3	**18**	3		6	19	4			18	1						
4	4	25	7	7	3			5	2			4	1	4	1	4	1
5	12	5	3	3	1	3	1	3	1							2	1

Perhaps the most significant fact brought out by these comparisons is the uniform tendency of a correspondence between rapid height growth and average numbers of sprouts and stumps. The most prolific sprouters are likewise the most rapid growers. The only striking exception is the Red Maple, in which the growth in height does not keep pace with the number of sprouts produced.

At twenty-five or thirty years of age the more vigorous sprout producers retain from four to five sprouts per clump, while others are reduced to two or three. Other factors, however, enter into the problem. The ability to bear shade enables some kinds of trees to retain their sprouts more easily, although these have a tendency to remain stunted permanently under the boughs and foliage of the trees that surround them. Others, less tolerant of shade, like the chestnut, are able to retain a comparatively large number of sprouts, because by their rapid and persistent growth they soon secure for themselves the upper crown spaces in the forest. More important, they usually maintain that position because of the early decline in the rate of growth common to all sprout reproduction. The development of seed-grown trees is notably different. In sprout forests, therefore, the occasional trees of seed origin will ultimately attain the ascendency over the sprouts, provided they are good shade bearers and well suited to the situation.

There are thus two important factors, natural sprouting capacity and shade endurance, that have a bearing upon the average

number of sprouts in a clump, but it is not easy to separate one factor from the other. Having considered the natural sprouting capacity in Table II, an attempt is made in Table III to determine the effect of light and shade, both upon the number of sprouts and upon their development. The figures have been derived from counts and measurements made upon two hundred and twenty-four felled sample trees selected from many different situations throughout the three types of forest. The ages ranged from twenty to forty years for the two slope types, and from thirty to sixty for Oak Ridge; or, in other words, the figures are based upon middle-aged to mature sprout forest conditions. As the question involved was the influence of light and shade, the sample trees were chosen from among the intermediate and dominant sizes within each tract, because the conditions of light are least complicated in the upper tiers of the forest and can therefore be more safely compared.

By comparing the average heights of the sample trees by species, within each type, with the corresponding number of sprouts in the clump (columns 4 and 3 in the table), a general correspondence in the sequence of numbers is noticeable. The taller the dominant or intermediate tree within each type,* the greater also is the number of sprouts growing with it in the clump. This may be partly explained by a greater natural sprouting capacity, but undoubtedly it is due in part also to the fact that sprouts, having once secured a dominant position, maintain it without serious difficulty.

The table shows no variation in the average number of sprouts per clump for chestnut on the two slope types. Chestnut Oak and Pignut, however, diminish in going from Mixed Slope to Oak Ridge, notwithstanding the decided increase that they show in the total number of trees to the average acre according to Table I. The decrease in the average number of sprouts per clump and the increase in the trees per acre are, in fact, due to the same cause: a decided falling off in the quality of the soil; for the exclusion of certain species from the Oak Ridge type leaves the less fastidious ones in undisputed possession of the ground.

* On Oak Ridge, where the forest growth is unusually open, the correspondence between height and number of sprouts is not maintained throughout.

TABLE III.—*Effects of Light and Shade on the Development of Sprouts.*

Type	Species	Average number of sprouts in the clump	Average height of sample trees (feet)	Average clear length of sample trees in decimals of the height	Average crown density of sample areas
Chestnut Slope.					
	Chestnut, ...	4.5	48	.65	.8
	Red Oak, ...	3.5	39	.63	.8
	White Ash, ...	2.0	36	.70	.8
	White Oak, ...	1.3	31	.63	.9
Mixed Slope.					
	Chestnut, ...	4.5	54	.64	.8
	Red Oak, ...	2.8	40	.62	.8
	Chestnut Oak,.	2.5	37	.66	.8
	White Ash, ...	2.2	34	.68	.8
	Pignut, ...	1.9	34	.62	.8
	White Oak, ...	1.3	34	.65	.9
Oak Ridge.					
	Red Oak, ...	2.9	31	.57	.7
	Chestnut Oak,.	2.1	32	.60	.6
	White Oak, ...	2.0	29	.70	.6
	Pignut, ...	1.3	24	.69	.6

The figures in the last two columns of the table show an interesting relation between crown densities and clear lengths. The figures in column 6 show in a rough general way the shade-enduring capacity of the several species within each type, according to the generally accepted law that trees with dense foliage (shade producers) are likewise good shade bearers. This principle is further supported by the figures in column 5. Comparing these figures with those in column 6, it will be noticed that the higher the degree of density the shorter is the clear length, or, in other words, the longer the crown in proportion to the full height of the tree. The notable exceptions are Red Oak and Pignut on Mixed Slope and Pignut on Oak Ridge.

That greater densities should produce shorter clear lengths may appear surprising and contrary to general observation, but it should be remembered that these results refer to separate species as compared with one another on the same type of forest, thus showing individual characteristics rather than general tendencies. On the Oak Ridge type, when compared with the two others, Red Oak and Chestnut Oak show the usual effect of opener growth upon the development of the crowns.

The figures for White Oak are the most interesting and indicate a tendency in this species that the writer has observed to be

rather general throughout its range. Since the plots from which the samples of White Oaks were taken show the greatest crown densities on the two slope types, we should expect from the foregoing the clear lengths to be *shortest*. That they are disproportionately long is due to the fact that the White Oak is one of those long-suffering species that make no attempt to rise above the neighboring trees; or, if so, do it only very slowly. While this species can hardly be called tolerant as compared with Hard Maple or Red Spruce, for example, it possesses the ability of the spruce, though in a minor degree, to bide its time and take advantage of the first opening to shoot upward.

The number of sprouts to a clump depends not only upon natural capacity and light, but partly also upon the size of the stump. In connection with the measurements for Table III a record was kept for each sample tree of the size of the stump from which it had sprouted, of its position near the base or the top of the stump, of the extent to which the latter had decayed, and of the corresponding condition of the sprout at the butt. These records show that Chestnut stumps resist decay longest, while White Oak comes next in its power of resistance. But precisely the reverse is true of the sprouts, for these were found full of defects at the base in the case of Chestnut, while they were much sounder in the five remaining species. On Mixed Slope 25 per cent. of the Chestnuts were defective or rotten at the butt and on Chestnut Slope 50 per cent. were thus affected. Apparently the richer soil of the latter situation is better adapted for their early development, but the former seems to produce more favorable results in the long run. Moreover, on Mixed Slope the height growth of Chestnut, as well as its rate of diameter growth (as will be shown later), is more rapid than on Chestnut Slope. When, therefore, we find it greatly exceeding in numbers on this lower slope, as was shown in Table I, we must conclude that the Chestnut has usurped the lower soils through some accidental circumstance, as, possibly, the greater ease with which the heavy nuts have found their way to the foot of the slope.

In Table I the average number of trees per acre was given by species for each of the three types of forest. In making the surveys the following information was noted in addition to the number and sizes of the trees: exposure, or the direction in which the

tract faced; character of the topography; quality of the soil; condition of the humus; composition of the surfacegrowth and undergrowth; composition and amount of seedling reproduction; average crown density of the trees. A careful comparison of these records made it possible to determine some of the habits and requirements of some of the more important species, of which the following is a concise statement:

Chestnut.—Most abundant on gentle and moderate slopes and on fresh, granular soil. Of thrifty growth under rich, well-decomposed mold; but is more persistent both in its height and diameter growth, and has fewer internal defects, on soils more meager in quality. Average crown density: .83.*

White Ash.—Prefers a fresh to moist, granular, loamy soil and is found most frequently on easterly exposures. Average crown density: .87.

Bitternut Hickory.—Prefers a fresh, loamy, somewhat deep and not too stony soil, and a rich, mellow humus. Generally occurs on easterly and westerly exposures, but tends to swing towards the north. Average crown density: .82.

Pignut Hickory.—Occurs abundantly on loose, meager soil, and withstands a poor, acid humus. The top soil is often a dense, spongy tangle of huckleberry roots. Is found on easterly and westerly exposures, but like the bitternut tends to swing towards the north. Average crown density: .72.

Black Birch.—Prefers a fairly good soil. Occurs most frequently on westerly exposures. Average crown density: .85.

Hop Hornbeam.—Prefers a good, granular soil. Decidedly prefers westerly exposures. Average crown density: .82.

Black Cherry.—Frequently occurs on rocky, shallow, inferior soil. Grows best, however, on moderately rich, well-drained soil, but is often excluded on account of its intolerance.

Chestnut Oak, White Oak, Red Oak.—These three species (also Pignut, see above) are decidedly the commonest on the poor, meager, yellow soil of the ridges, which is almost always overlaid by a tough, spongy, fibrous, acid surface soil. The Chestnut

* The densities are the averages for the tracts where the species were found most abundantly, and probably represent the upper limits of density under otherwise favorable conditions. In the tables these densities, mathematically averaged, have been rounded off to the nearest decimal.

Oak is the typical tree in these situations. Blueberry, Huckleberry, Shadbush and moss chiefly constitute the ground cover and undergrowth.

Forms of Reproduction. Reproduction in sprout forests consists mainly of young sprouts, although seedlings find entrance here and there and ultimately grow into the stand. In addition to these two forms there is a third, commonly found throughout most of our second-growth deciduous forests, which may be said physiologically to stand between the two others. For want of a better name it may be called "seedling-sprouts."

At the first glance these seedling-sprouts appear to be merely seedlings, but on being removed from the soil it is seen that, in place of having a true independent root system, they are attached just beneath the surface of the soil to the stub of a former small stem. The latter in turn is attached to a connected series of short, underground stems, which usually retain rounded scars near their upper ends. Sometimes this system of stems is fairly straight and of approximately even thickness throughout; but much oftener it is gnarled and twisted and has altogether the appearance of a disproportionately large, club-shaped, distorted root. True roots and rootlets appear at the farther extremity. (Pl. III, Figs. 1 and 2.)

Such forms of growth are derived from true seedlings. This was shown by a study of several hundred specimens of various sizes and ages, including most of the species represented in these forests. The investigation showed that a large number of seedlings are for various reasons sooner or later arrested in their development and then undergo a change in the following manner. Usually at the age of twelve to eighteen years, but in some cases much earlier, the seedling, which even until then has been growing very slowly, shows a sudden loss of vitality. A sprout now appears at the base of the stem, generally at the surface or just beneath the surface of the soil. Its rate of growth, at first normal, soon slackens, and before it has attained the size of the stem from whose base it sprang its annual growth is reduced to a minimum. A new sprout then apears as before at the base and prolongs the underground stem. After a time there is a tendency to multiply the sprouts, so that from two to six appear at the same time. This marks the final stage, for soon after this the whole

plant usually dies and the subterranean root and stem system finally disappears.

The age and size that these suppressed forms of growth will attain underground vary widely under different conditions. Thirty years is probably a moderate estimate of the average age, while extreme specimens will attain fifty or sixty years and may reach three or four feet in length and several inches in diameter at the thickest parts. The lease of life depends of course as much upon the presence of foliage above ground as upon the roots below. The underground stem portion, however, appears to be imperfect in its functions and the final cause of the death of the plant. For as this underground stem grows older it fulfills partly the office of a stem and partly that of a root, without being either of these distinctly. The annual rings which ought to be evident are imperfect and ill-defined, or wanting altogether. New roots rarely grow from these parts. Gradually decay, spreading out from the numerous scars left by the death of former sprouts, gains upon the younger sections of this underground growth. The connection between root system and sprouts becomes more and more imperfect as the walls of the intermediate stems become thinner and trough-like in form, until decay finally severs the connection altogether.

This peculiar phenomenon of growth may be observed in most of our second-growth deciduous forests, though it appears heretofore to have received little or no attention from foresters. It is much more common in sprout forests of long standing and may be explained partly by the dense shade under which seedlings have to suffer in such forests, and partly also by the excessive amount of dead branches, bark, and leaves constantly shed from the surrounding trees, the greater number of which die as the forest grows older. Many seedlings were found bent over and pinned to the earth by such refuse, with a new sprout starting at the base of the stem. Finally, a certain number of the seedlings, especially among the oaks, are continuously kept back by nibbling squirrels, rabbits, and mice, and having small recuperative power are soon transformed into seedling-sprouts.

To determine the relation between the older growth and these various forms of reproduction one or two sample plots were selected for study within each of the forty-four valuation surveys

referred to in Table I. These sample plots were made fifteen feet square. In most cases one plot sufficiently represented the average conditions of the tract; in others two sample plots were selected, representing respectively the best and the poorest conditions within the tract. The quality of the soil and humus, and the age, compositon and general character of the surrounding stand within a radius of fifty feet, were noted. The result of this study is shown by averages in Table IV, the figures having, however, been approximated to areas of 1/20 acre. It should be added that only the younger seedling-sprouts, that still showed some vitality, were included in the counts, while all sprouts above three feet in height were excluded as belonging to the older growth of the forest.

The salient features in this table are the following: Seedlings and seedling-sprouts predominate. Oak Ridge, with lowest crown density, leads the other two types in all three forms of reproduction. If, however, we exclude the Chestnut Oak from the totals this type stands about midway between the two others. On the whole, the reproduction within each type is fairly well proportioned to the stand of the older trees, as may be seen by comparing the results with those in Table I. With some important exceptions the future composition of the forest is foreshadowed in the present reproduction; although, of course, only a very small percentage of it ever grows into the stand, owing to the immediate domination of the larger sprouts after every clear cutting.

The exceptional species in the table are the Chestnut, Bitternut, Ash and Hard Maple. On both of the slope types chestnut reproduction is entirely disproportionate to its older representation in the forest, being even less on Chestnut Slope than on Mixed Slope. This may be partly explained by the intolerance of the Chestnut when compared with several of its competitors,* as well as by the somewhat greater crown density of the Chestnut Slope sample plots (.90).

On Mixed Slope the reproduction of Bitternut and Ash is abundant as compared with Chestnut, but its promise is not quite

* The following are average crown densities under which reproduction was found to occur most abundantly: For Chestnut, .80; Hard Maple, .85; White Ash, .86; Bitternut Hickory, .87.

TABLE IV.—*Amount and Character of Reproduction on Sample Areas of 1/20 Acre in Three Types of Forest.*

	Chestnut Slope			Mixed Slope			Oak Ridge		
	Seedlings	Seedling Sprouts	Sprouts	Seedlings	Seedling Sprouts	Sprouts	Seedlings	Seedling Sprouts*	Sprouts
Chestnut, ...	5	2	2	7	6	4	2	..	..
Chestnut Oak, ...	22	6	..	100	49	11	452	68	68
White Oak, ...	2	..	3	3	3	..	13	16	3
Red Oak, ...	2	1	..	6	6	..	6	8	8
Black Oak, ...	..	..	..	..	..	..	1	..	14
Bitternut, ...	4	5	1	16	4	..	2	..	..
Pignut, ...	1	2	..	5	3	2	8	13	1
Shagbark, ...	..	..	..	1	..	..	1	..	2
White Ash, ...	2	4	1	63	7	8	3	..	..
Hard Maple, ...	31	12	..	16	4	11	..	11	..
Red Maple, ...	7	12	10	89	1	1	5	6	6
Hop Hornbeam, .	10	2	..	8	1	3	40†	..	..
Other Species,‡ ..	3	..	1	2	4	3	4	..	..
Total, ...	89	46	18	316	88	43	537	122	102
Grand totals,		153			447			761	

Average Crown densities of the Sample Areas and Average Ages and Heights of the Reproduction.

	Density.	Seedlings yrs.	Seedlings in.	Seed'l yrs.	Sprouts in.	Sprouts yrs.	Sprouts in.
Chestnut Slope, ...	.90	5	5	7	7	4	9
Mixed Slope, ...	.85	4	5	4	5	4	13
Oak Ridge, ...	.80	4	5	4	6	4	9

fulfilled in the amount of the later growth. (Cf. Table I.) The young reproduction of both species, especially of the Bitternut, favors the better soils. The older sprout growth is well maintained in the much opener situations of the Oak Ridge type. The Hard Maple, on the other hand, maintains itself best on Mixed Slope. On Chestnut Slope its seedling reproduction, however, is persistent and long-lived.

The remarkably abundant seedling reproduction of Chestnut Oak is, of course, explained by its extremely frugal demands upon the soil. It is the characteristic tree of the rocky open situations of the Oak Ridge type, where its reproduction often crowds into the hollows between the rocks to the exclusion of all other species.

* Only seedling-sprouts retaining some vigor and sprouts under three feet in height were included in these averages.

† Found on best soil and mould within this type.

‡ Under "other species" are included the following: Butternut, Beech, Black and Choke Cherry, Basswood, Dogwood, and Shadbush.

In a somewhat similar way Hop Hornbeam usurps the better situations within this type. The reproduction on Oak Ridge of the four leading species of this type in Table I was found to be most abundant under the following average crown densities:* White Oak, .64; Pignut, .65; Red Oak, .71; Chestnut Oak, .73.

Rate of Growth.

The basis for a study of the rate of growth was furnished by 435 trees, including all the important species. Complete stem analyses were made of these trees in 8-foot sections and for 5-year periods of growth. Small suppressed trees were separated from the remainder in recording the measurements. These were sectioned into 4-foot instead of 8-foot lengths in order to preserve the same degree of accuracy in the results. The ages of trees of seed origin could be determined with fair exactness by the help of the averages in Table IV. While a large number of curves were constructed from these data, only a few have been chosen here for illustration.

The trees upon which the curves in diagrams 1 to 3 are based were selected very carefully to represent average shape, crown density, health and general conditions of growth. It was not always possible to find representative trees in sufficient numbers for all species on every type. Consequently the curves indicate the averages only of those species within each type that were fairly well represented. On account of the careful method of selection, it is believed that the number of trees necessary in any case to construct a reliable curve was very much smaller than would ordinarily be required where trees are selected with less discrimination, perhaps, but the results made to depend upon averages of a larger number.

At the end of each curve the second number, in brackets, refers to the actual number of trees analyzed and used for the curve. Whenever this number was insufficient to include trees of all ages, the intermediate points along the curve were found by tracing back the heights and diameters of some of the older trees to their earlier ages by help of the detailed measurements of the stem analyses. These additional points, added to the actual number of

* In the tables, these densities, mathematically averaged, have been rounded off to the nearest decimal.

trees, have given the larger figure of specimens involved that precedes the one in brackets on each curve. It was thus possible to find out how fast the trees grew during the earlier stages of development and to base a curve throughout its length upon uniform conditions. In this way it is believed more accurate results have been obtained than would have been possible if small and suppressed trees that were then growing on the same tract had been selected for the earlier and intermediate periods of life. These suppressed trees are represented by separate curves in the diagrams.

In diagram 1 the curves for dominant sprouts show a rapid rate of height growth, but it falls off rather early and thereafter diminishes gradually to the end of the curve. Thus on Chestnut Slope the rate is 12.5 feet for the first 5-year period and only 6 feet for the sixth period. On Oak Ridge these proportions are nearly cut in half. On Mixed Slope the figures at first stand about midway between, but the rate as compared with Chestnut Slope is better maintained toward the end of the curve. For suppressed sprouts, on the other hand, the situation is reversed; for here the early rate is most rapid on Mixed Slope, and, as before for the dominant sprouts on Chestnut Slope, is followed by a more sudden diminution, until it falls to the rate of the corresponding curve on Chestnut Slope in the fifth 5-year period. On Oak Ridge the suppressed sprouts begin life much more slowly, but continue at a comparatively faster rate to the end of the curve. In a word, the same tendency runs through all the sprout curves: a rapid development at the beginning generally points to a comparatively early decline.

The curve for dominant seedling trees on Oak Ridge overtakes the sprout curve at 42 years of age, but remains behind on Mixed Slope. On the latter type the sprout curve is based upon a large proportion of chestnut trees, whose growth is decidely more rapid than that of any of the other species.* The suppressed seedlings on Chestnut Slope show a surprising increase up to the thirtieth year, after which the curve tends to turn and fall. The explanation probably lies in the good soil conditions of Chestnut Slope. The rapid growth of the dominant sprouts during the first ten

* On Chestnut Slope the number of dominant seedling trees was not sufficient to construct an accurate curve; hence none has been given.

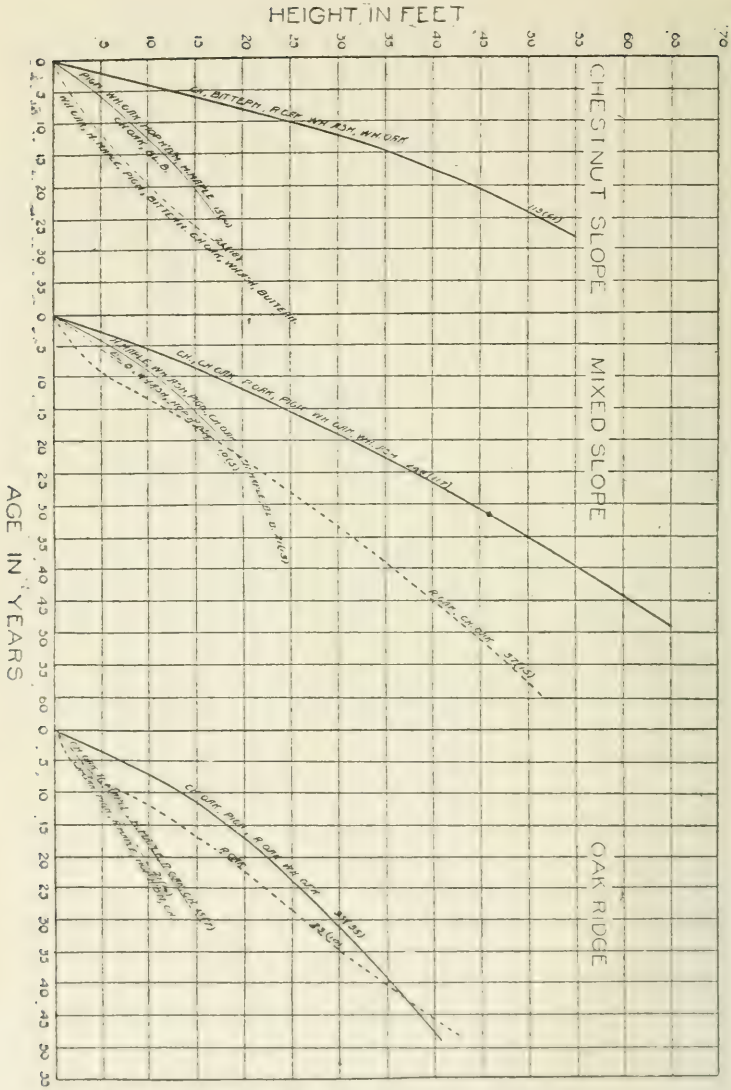


Diagram 1.—RATES OF HEIGHT GROWTH

Dominant Trees { Sprouts ——— / Seedling Trees ———

Suppressed Trees { Sprouts ..... / Seedling Trees .....

years apparently retards the development of the young seedling trees. The latter gradually recover in the course of the succeeding decades, but very few of them ever succeed in catching up with the much taller sprouts that have preceded them. There is, in fact, strong reason to believe that a large proportion of what appear to be suppressed seedling trees in these forests are in reality seedling-sprouts.

In diagram 2 the average curves for age and diameter are given for comparison with the height curves of diagram 1. The steady increase in the rate of growth for sprouts looks as if the growth energy had been gradually transferred from height growth to diameter growth. But the latter is also accelerated rather than diminished where the height growth is proportionately more rapid, as may be seen by comparing the rates of height growth of the dominant sprouts on Mixed Slope and Chestnut Slope (diagram 1) with the rates of diameter growth on the same types in 5-year periods. The same tendency is noticeable in the suppressed sprouts. On Oak Ridge it will be remembered these began with a slow height growth, but increased proportionately faster than the other two. A comparison of the diameter curves shows the same relation for the diameter increment. We may conclude, therefore, that up to the age of about thirty-five years, if not longer, sprouts growing under conditions similar to those of western Connecticut will be favorably rather than unfavorably affected in their diameter growth by a rapid increase in height.

The seedling trees likewise show an increase in the rate for diameter with each succeeding 5-year period, but it is barely perceptible. Nor does the relative rate of diameter increment on the different types correspond with the relative rate of height increment. The latter is faster on Oak Ridge than on Mixed Slope for dominant seedling trees (up to 25 years), yet the diameter rate is comparatively a little slower. In the case of suppressed seedlings it is worth noting that a slow progress in height growth on Oak Ridge is accompanied by an increase in the rate of diameter growth that is distinctly more marked than on either of the other types. In other words, seedling trees show the effect of a rapid height growth in a diminished diameter growth. However, this interrelation between height and diameter growth in seedling

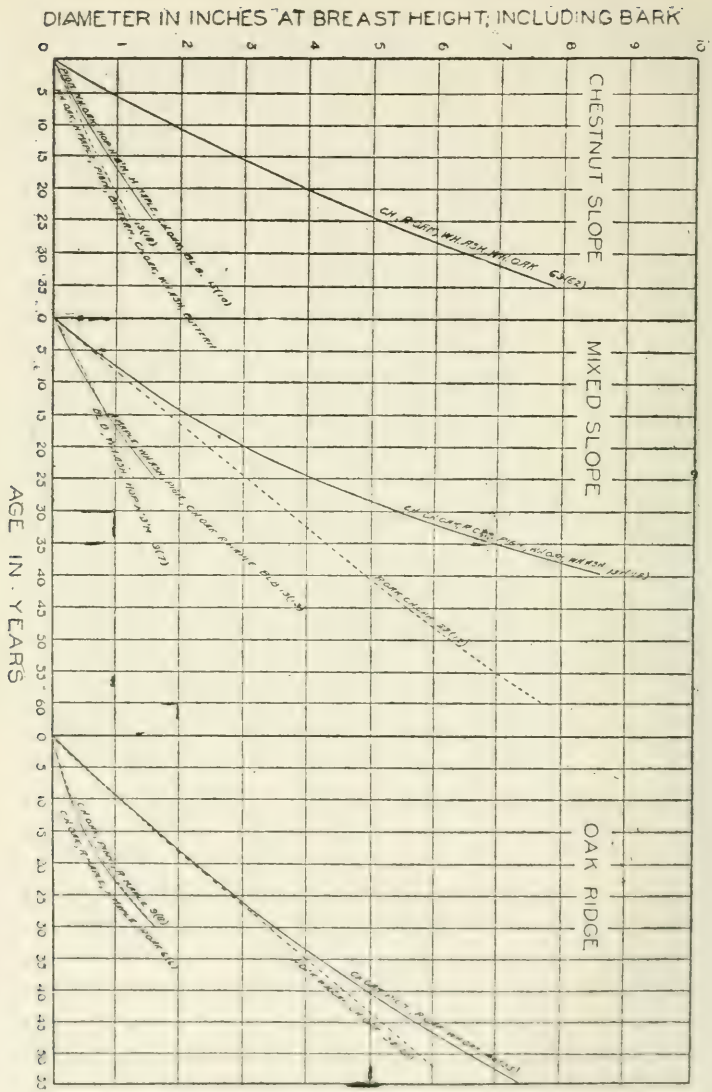


Diagram 2—RATES OF DIAMETER GROWTH

Dominant Trees { Sprouts ——— / Seedling Trees - - - -

Suppressed Trees { Sprouts ..... / Seedling Trees .....

trees probably does not assert itself as early as here under ordinary forest conditions.

Diagram 3 gives the results in volume.* These curves speak largely for themselves. The rapid rate for dominant sprouts on the two slope types is due chiefly to the very rapid diameter growth of chestnut.

Yield.

To determine the yield forty-four half-acre sample areas were measured off in the form of rectangles on the three forest types as follows: twelve on Chestnut Slope, twenty-two on Mixed Slope, ten on Oak Ridge. All trees over six feet in height and one inch in diameter at breast height were included and were classified according to species and sprout or seed origin into 1-inch diameter classes. The calculation of volume was made according to Robert Hartig's method, the total number of inch classes being divided into three groups and three sample trees chosen within each group. The sample trees were sectioned into

* The method of calculation for the volumes of the individual trees that supplied the points for these curves differed slightly from the method in ordinary use. It consisted in multiplying the sum of the areas at the section cuts in each tree (except the cut at the stump) by the common length of the sections, namely, 8 feet for dominant trees and 4 feet for suppressed trees. This obviated the necessity of finding the mean basal area of the two ends of each section, and at the same time extended the calculation a half section above the upper-most cut, while it also left a half section above the stump to be calculated separately. The very top of the tree, being small and spindling, could thus be disregarded altogether and classed with the branches, while the volume of the lower half of the lowest section could be found very approximately by multiplying the mean between the basal area at breast height (which is taken at 4.5 feet) and the basal area of the stump, by the length of this half section, namely, 4 feet for the larger class of trees. For the suppressed trees a double mean had to be calculated for the butt end of 2 feet.

This modification of the usual method was very well adapted for the present purpose, because the stumps were usually cut about 1 foot high and the basal area at breast height would thus fall 6 inches below the upper end of the half section whose volume was to be ascertained. Theoretically it may seem that this would give a result slightly in excess of the actual values, but in reality it constitutes an approximate allowance in the case of larger trees for the flare above the roots; whereas in smaller trees, which are less bulgy at the base and which are usually cut only 6 inches high, the chosen diameters at breast height and at the stump would give the actual mean desired. This method of computing the volume greatly simplified the mathematical work, while the results were found by comparison to be very close to those obtained by the ordinary method, being in general a little lower and therefore more conservative. In the curves the volume of the branches, as well as of the stump, was excluded.

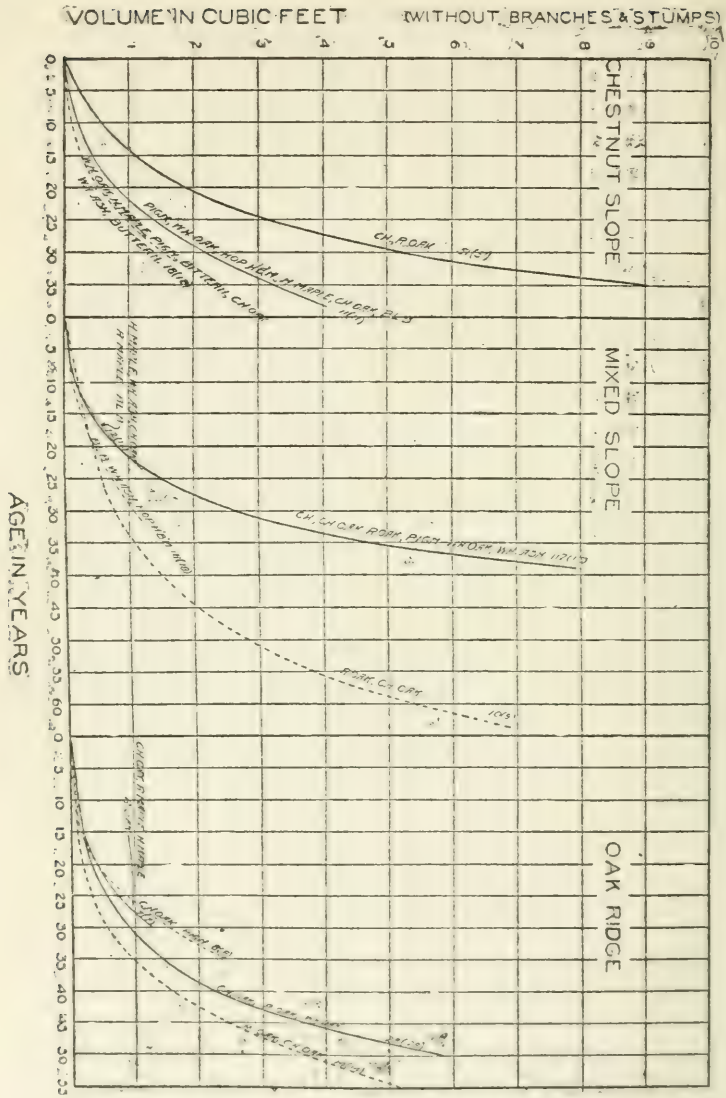


Diagram 3—RATE OF VOLUME GROWTH

Dominant Trees { Sprouts ———— / Seedling Trees ————

Suppressed Trees { Sprouts ..... / Seedling Trees

8-foot lengths for dominant trees and into 4-foot lengths for suppressed trees.

In addition to the counts and measurements a complete record of the silvical conditions was kept for each sample area. This included a "quality of locality" in three grades, based upon the quality of the soil and mold and the thriftiness and general appearance of the trees.

The results of these records and measurements are shown in Table V. The yield is there referred to age and to basal area at breast height. As referred to basal area the yield on the whole shows more regularity in the sequence of the results; in other words, there is a consistency in the relation of silvical conditions to yield. Basal area is dependent on crown development and crown development on soil conditions and environment. It should also be remembered that trees are more tolerant and therefore have denser, fuller crowns, the better the soil. This is shown in the table by the general tendency of higher densities for better qualities of locality within each type of forest. Of course, there are some marked irregularities in the columns of yield as referred both to age and to basal area, but these can in most cases be explained by reference to the columns of "quality," "crown density," and especially "percentage of chestnut," which is a tree of ampler crown, more cylindrical bole and greater average height than the other species. Thus, on Chestnut Slope, sample areas 3 and 9 yield more than 4 and 10 of the same ages, because they have both greater crown densities and higher percentages of chestnut. The same is true for areas 14 and 33, 26 and 27, and 16 as compared with 17, 15 and 30. In area 34 as compared with 33 the quality of locality and crown density are the determining factors. Special cases are areas 11, 13 and 30, in which the comparatively low yield is explained by slow growth and scrubby forms resulting from years of excessive pasturage; area 19, in which the high yield is due to a very thrifty growth of oaks, which here form the dominant stand; area 8, in which a large number of trees per acre, in spite of their small size, has been the factor of influence; and areas 41 and 42, in which a proportion of 52% and 48% of hickories, with tapering crowns, has reduced the yield. Finally, area 5 with the highest yield of the entire series deserves special notice. This yield is explained partly by the very excellent

TABLE V.—*Yield of Sprout Forest in the Housatonic Valley, Connecticut.*

Sample area No.	Quality	Crown Density	Chestnut per cent.	Basal area sq. ft. p acre	Average age years	Yield* cords p. acre
Chestnut Slope.						
11	II	.9	61	53.4	19	8
12	II	.8	38	63.	19	11.6
7	II	.8	44	74.6	21	13.6
1	I	.8	55	81.4	21	18.7
2	I	.8	45	60.2	22	14.1
6	I	1.	39	109.6	28	19.8
10	II	.7	41	89.8	29	20.1
9	II	.8	54	92.9	29	21.4
4	I	.8	39	83.9	35	19.9
3	I	.9	46	99.9	35	23.7
8	II	.8	32	118.5	36	26.3
5	I	.9	39	121.3	42	33.7
Mixed Slope.						
21	II	.9	2	35.9	12	3.4
23	III	.8	1	30.5	12	3.5
22	II	.9	7	47.6	12	5.3
13	II	.7	26	48.1	19	8.6
25	I	.8	28	61.	21	10.4
27	II	.7	..	36.6	23	5.4
26	II	.8	8	58.1	23	10.
29	II	.8	36	86.4	24	17.3
30	II	.8	25	93.6	30	21.8
15	I	.9	23	92.1	30	21.9
17	I	.9	25	103.8	30	26.1
16	I	1.	26	115.1	30	29.1
28	II	.9	10	76.1	31	16.2
31	II	.9	28	78.7	31	20.
32	II	.9	21	95.8	31	23.6
34	III	.8	9	47.9	38	10.6
33	II	.9	7	70.3	38	14.5
14	II	.6	5	44.8	48	8.4
18	II	.7	13	92.1	54	19.4
24	II	.6	2	78.6	55	17.1
19	I	.8	6	107.5	56	29.7
20	I	.8	15	88.1	57	18.6
Oak Ridge.						
38	III	.6	..	33.5	18	3.6
43	II	.8	..	54.9	32	6.7
42	II	.7	..	60.7	32	8.5
44	III	.6	13	56.6	32	9.
36	II	.7	14	91.9	35	16.1
35	III	.6	6	57.8	38	10.8
41	II	.6	..	69.1	44	11.5
40	II	.5	1	65.4	45	12.6
39	III	.7	..	81.3	53	16.
37	III	.6	..	68.1	56	13.7

* In the calculation of the yield the volume of the branches has not been included. Test measurements on four of the tracts indicate, however, that 5 to 8 per cent can be allowed for utilizable material on stands over thirty years of age.

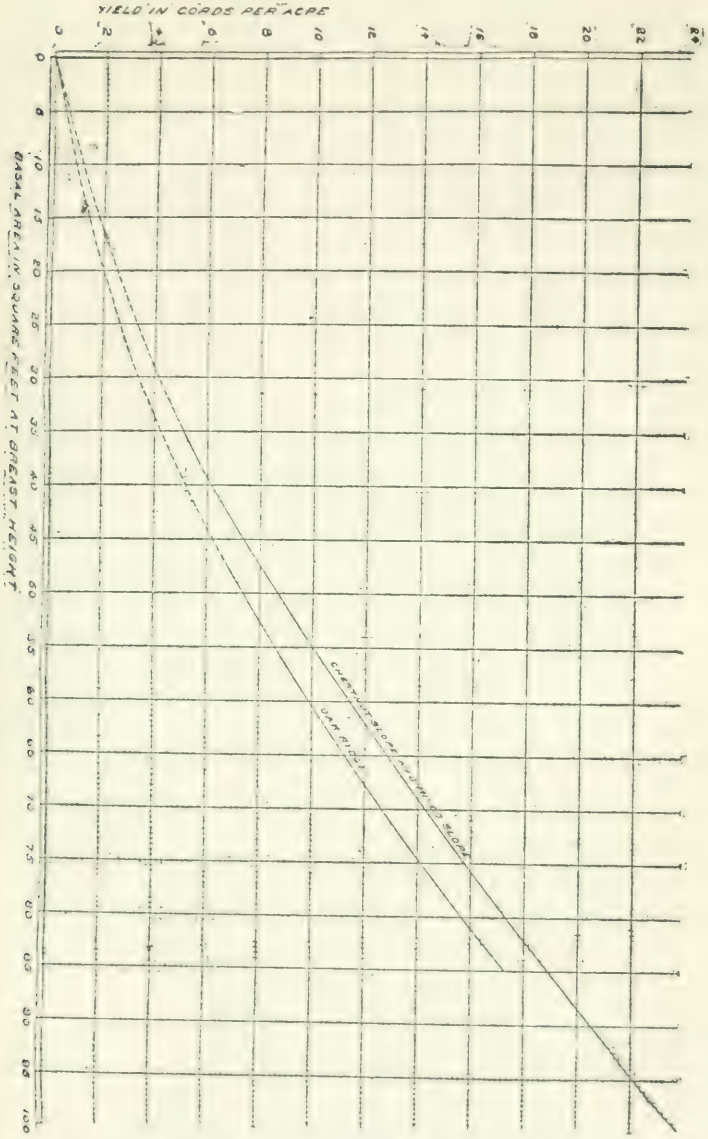


Diagram 4—YIELD IN CORDS PER ACRE, AS REFERRED TO BASAL AREA.

soil conditions and a favorable situation, but mainly by the history of the area. For some twenty-five years past the owner of this tract had applied to it a careful system of improvement cutting, removing a considerable number of unshapely and otherwise undesirable trees. The number of trees per acre was thereby reduced from the average number for this type, 929, to 574, and 210 of these remaining trees were of seed origin, mostly under 5 inches in diameter. This shows that it is possible on good soil and by judicious treatment not only to increase the yield of sprout forests, but at the same time to improve their composition and consequently their commercial value.

In Diagram 4 graduated curves have been constructed from the figures of yield in Table V, in order to show the differences in yield for like basal areas on different types of forest. In this diagram the two slope types have been combined into one curve on account of the similarity of the conditions of growth. The lower sections of the curves are only approximate, having been determined from the general direction of the middle and upper sections.

From this table (V) the periodic yield may be approximated to run about as follows, rounded off to half cords:

Age, ...	20	25	30	35	40	45	50	years.
Chestnut and Mixed Slope,.	11.5	15.5	19.5	21.5	23	24	24.5	cords.
Oak Ridge, ...	3.5	6	8.5	10.5	12.5	13.5	14	cords.

The foregoing analysis shows how very important a factor silvical conditions must be in all estimates or predictions of volume and yield. These conditions must even be more carefully considered in our own country, even in comparatively regular forests, than in the well-organized and uniform forests of Europe.

Fires and Other Dangers.

Fires.—The subject of forest fires has now been widely discussed for years and our forest literature is full of information about the causes, character and means of prevention of this universal evil. Very little remains to be said in this place.

On account of the density of the stand and moderate heights of the trees, the crookedness and irregular forms of growth, and the low, straggly crowns, fires in sprout forests are more destructive

than in seedling forests of similar type. In the former, also, there are more dead and dying trees and more litter accumulates among the clumps of sprouts. (Pl. IV, Fig. 3.) In stands over twenty years of age some of the larger trees usually escape, particularly those with tough bark, like Chestnut, Oak, or such as by their position in the group are protected by their neighbors. In young stands, however, the destruction is often complete, while the dead, half-burned stems that remain standing add, of course, to the danger of a second fire.

In most fires all forms of young reproduction are destroyed. New shoots spring from the roots near the surface of the soil and thus constitute the reproduction in the new stand of trees. Much of this reproduction consists of "seedling-sprouts." Pl. IV, Fig. 1, shows a seedling sprout with two scars on the underground stem 21 and 25 years old, and three shoots, the largest of which followed the cutting of a sprout at the extreme left two years ago, while the two others are the result of a recent surface fire in which the larger sprout was killed. In Fig. 2 the sprouts are more vigorous, having come from a better preserved root-system.

Cattle.—Where pasturing is allowed in young sprout forests it retards the rate of growth and leads to scrubby forms. Most of the seedlings and surface growth are trampled to death and the soil is gradually hardened and compacted, the trees suffer, the leaf canopy grows more open, weeds and grasses enter and the forest gradually deteriorates. The number of cattle allowed to graze within an area should be regulated by the conditions of growth and the age of the trees.

Frost and Snow.—First year sprouts are particularly sensitive to spring frosts and early frosts in the fall on account of their extremely rapid growth, which leaves the top shoots tender and ill-prepared for resistance.

The danger from heavy snowfall when followed by rain and frost is generally recognized. Slender poles are bent over under the weight of the ice and snow and branches are cracked and broken off in the wind.

Forest Treatment.

Although the main object of this paper has been to set forth certain new facts regarding the silvics of these forests, a few paragraphs may here be added in reference to their treatment.

The forests of the Housatonic Valley in their present condition have comparatively little value as sources of wood supply. The manufacture of charcoal has been practically abandoned in this region and the supply of small wood is so plentiful that cordwood commands only a very low price. Most of the trees are of poor shape and small dimensions and the best that can be hoped for is a gradual improvement of the conditions through careful thinning and selective cutting. There is, therefore, no necessity at present for any regulation of the yield.

As trees are removed for firewood or the minor necessities of the farm the aim should be, first of all, to improve the composition of the forest. Slow growing species should be eliminated, resulting in combinations among the more valuable and rapid growing species. These combinations should, of course, be basd upon compatibility, as well as upon rate of growth* and intrinsic value. At the same time the effects of such changes in composition upon the soil conditions should be taken into consideration. The ultimate aim should be to transform the present crooked, partly diseased and defective, more or less effete, mixed stands, into stands of straight, thrifty, healthy trees, in the beginning largely of sprout origin, but to be replaced in course of time by seedling trees through natural regeneration. With the completion of these changes the time would come for a consideration of the best felling age as based upon marketable size, reproductive power, soundness as affected by age, and culmination of the "mean annual increment," whether in volume or board foot contents.

The best combinations appear to be the following.—On Chestnut Slope: the Oaks, especially Red Oak, with Chestnut in moderation; to which should be added in the opener places White Ash and Bitternut Hickory. On Mixed Slope: mainly Chestnut in combination with the Oaks, especially Chestnut Oak and White Oak, with admixtures of the Hickories, Ash and Maple in suitable situations. In both types occasional specimens of Basswood, Hop Hornbeam, Black and Yellow Birch, should be

* The limits of space did not make it possible to include curves of growth for separate species in the section on Rate of Growth. Among the important species the rates of volume growth on the two slope types showed the following sequence, beginning with the fastest: Chestnut, red oak, pignut hickory, white ash, chestnut oak, white oak.

favored in spite of their slower growth. In open or moderately open stands small Hard Maple and Beech should be retained for maintenance of the soil conditions and cleaning of branches of the older trees. On Oak Ridge cutting is unprofitable, except at very long intervals, on account of slow growth, scrubby forms and inaccessibility. Moreover, the soil conditions and situation point to the advisability of reserving these areas as protection forests.

To facilitate the gradual conversion of the sprout into the seed system the selection cuttings should be kept fairly dense and the trees should preferably be cut during August or July.

The foregoing operations, while reducing the stand of trees per acre, would almost certainly increase the yield; as was shown, for example, in the case of sample area No. 5. The improvements in selection of species and merchantable quality, as well as the ultimate rise of timber values that may confidently be expected, would all contribute still further to the increased returns per acre.

In this connection it may be added, moreover, that the forests of the Housatonic Valley, as well as their extension into the Berkshire Hills of Massachusetts, have a decided esthetic value. The resorts and beautiful drives and walks in this region have for many years been the attraction of pleasure seekers from neighboring and distant States. Many owners will here set greater value upon their forests as adjuncts to their homes than as sources of wood supply. The conversion of sprout growth into a high selection forest, with the retention of some of the more ornamental trees and shrubs among the undergrowth—such as Beech, Hornbeam, Dogwood and Shadbush—as a protective soil cover, will ultimately meet both of these conditions.

Summary.

(1.) The sprout forests of the Housatonic Valley can be classified into three distinct types: Chestnut Slope, occupying the bases of the hills, with chestnut predominating; Mixed Slope, on the sides of the hills, with a large admixture of the oaks, maples and hickories; Oak Ridge, along the crests, with much shallower, poorer soil, supporting a stunted growth chiefly composed of chestnut oak.

(2.) Sprout reproduction varies according to species, condition

of stump and quality of soil. There is an attempt at adjustment between the old root system and the new generation of sprouts. Under favorable conditions new sprouts, especially of the hickories, send out independent roots near the surface of the soil. Successive cuttings complicate the connection between sprouts and root system; cattle, fires and spring frosts lower the quality of growth, and the soil, which is severely taxed, gradually becomes exhausted.

(3.) A study of the natural sprouting capacity of the various species shows that the most prolific sprouters (Chestnut, Red Oak, Chestnut Oak) are likewise the most rapid growers. Their rapid growth is of distinct advantage, because they are thereby enabled to reach and *maintain* the upper crown spaces. White Oak shows a valuable tendency to recuperate after long suppression in the shade.

(4.) Seedling reproduction is limited in these sprout forests on account of dense shade, injury and suppression through fallen branches, fires, browsing of cattle, nibbling of mice, etc. Most of the seedlings are ultimately transformed, by repeated attempts at sprouting, into "seedling sprouts" with disproportionately large, distorted, defective root systems. Many of the latter attain great age, but they become more and more complicated and imperfect in their functions as they enlarge by addition of parts of the overground growth, and finally succumb to decay.

On the three types of forest the reproduction of seedlings and "seedling sprouts" is fairly well proportioned to the stand of the older trees.

(5.) A detailed study of the rate of growth shows that although the sprouts, separated into dominant and suppressed trees, vary in their rate of height growth on the three types of forest, there is a tendency toward compensation: a rapid development at the beginning generally points to a comparatively early decline. Height growth, however, does not seem to interfere with diameter development, at least in sprouts; on the contrary a rapid height growth generally coincides with a rapid diameter development. In seedling trees this principle does not hold true, except perhaps in early life. In volume growth the two slope types greatly exceed the Oak Ridge type, chiefly owing to the very rapid rate of diameter growth of Chestnut.

6.) A detailed study of the yield shows a marked dependence of yield upon silvical conditions and a correlation between yield and basal area. Discrepancies in the tabulated results as referred either to age or to basal area can be explained in almost all cases by differences in "quality of locality," "crown density" and especially "percentage of chestnut." Graduated curves show a distinct difference in yield for like basal areas on different types of forest. The yield can be greatly increased and its quality improved by intelligent methods of thinning and selection cutting, combined with protection.

(7.) Fires are unusually destructive in sprout forests on account of the density and shortness of the stand, crooked forms of growth, and excess of dead material. There is also great danger of repetition of fires. Other dangers, more marked in this class of forests than elsewhere, are spring and autumn frosts, heavy snowfall and sleet, and indiscriminate pasturage.

(8.) On account of the economic conditions and excess of material of small dimensions and inferior shape, there is no necessity at present for a regulation of the yield. The aim of treatment should be to improve the conditions, especially the composition of the forest, by careful thinning and selective cutting. The species allowed to remain should be considered from the point of view of mutual compatibility, rates of growth and commercial value. Effects upon the soil should likewise receive consideration. A gradual transformation of sprout into seedling growth, by methods of natural regeneration, is desirable. Oak Ridge forests should be reserved as protection areas.

(9.) The forests of the Housatonic Valley, as well as of the neighboring Berkshire Hills of Massachusetts, should be considered also for their esthetic value. The conversion of the sprout form into a high selection forest, with the retention of certain ornamental trees and shrubs among the undergrowth, serving also as a protective soil cover, will ultimately meet this condition.

G. Frederick Schwarz.

ABSOLUTE FOREST LAND.

For the purpose of propaganda, before legislative bodies and in popular discussions, it is customary to assert that no agricultural land is required for forestry purposes; that all needs can be satisfied if the "waste lands" are devoted to timber growth. Probably these statements are accurate enough on such occasions, but it may be well if American foresters will in their own minds form a clearer notion of this subject.

German foresters long ago established the category of "absolute" forest land, meaning thereby land on which agriculture is unprofitable, and which should therefore bear forests. Taking their notions from the circumstances of their own country, they apparently assumed that land unfit for agriculture would always be capable of producing woods.* Moreover, the concept was formulated at a time when settlement had long been completed and practically all lands were in use, in other words, when agriculture was in a relatively static condition. In order to make the term "absolute forest land" serviceable generally, it must be analyzed more fully and defined more precisely than the Germans have found necessary.

The ideal economic organization of a country would be one where each parcel of land was devoted to the use by which the highest wealth could be produced on the totality of the land.

Productivity of land depends on two conditions: Fertility, determined by geological and climatic circumstances; and relative location, determined by the available means of transportation and distance from markets. Fertility changes but very slowly;† relative location is changing all the time, especially in new countries, by the springing up of new markets as population increases. Moreover, as the available capital and labor of a community mul-

* This assumption is not completely justified even in Germany. Not to mention the high Alps above timber line, it has been found during afforestations in such districts as the Luneburg Heath and the peat moors of Northwest Germany, that there are lands so utterly sterile that even Jack Pine will not grow except after difficult and expensive ameliorations.

† Except in case of natural catastrophies, as where a field is sanded up by a flood; also in cases of rapid erosion on a hill side.

tiplies, it becomes economically practicable to make production more intensive. Consequently, under conditions as they now exist and will for a long time continue on the larger part of the globe, the extent of land on which agriculture is possible must constantly vary, and on the whole increase.

Agriculture supplies the first human necessity, and demands the first consideration in the parcelling out of the land. In thinly settled countries, only a part of the land fairly adapted to farming is actually put to that use; but as development progresses, more and more land is brought under cultivation, and only those lands are left which on account of infertility or inaccessibility are unfit for the farmer. These then, so far as they are capable of bearing forests, would be absolute forest land. With further development more intensive methods of agriculture will become feasible, and a part of what was at first absolute forest land will now be agricultural. This process may conceivably continue until almost all the land is in agricultural use. For even the most sterile sands can be made fertile by manuring and irrigation, the most distant tracts accessible by roads, and the steepest mountain sides can be terraced if need be. It follows, then, that there is practically very little absolute forest land in the physical sense. Almost all lands except those climatically incapable of economic plant growth of any sort are physically available for agriculture. The definition must be modified in this way: "Absolute forest land is land capable of bearing forest but unprofitable for agriculture at any given stage of economic development."

There are of course limited districts in which no absolute forest land is to be found. But taking the world as a whole, it will be a very long time before agriculture has conquered all the land capable of plant growth. At present a very large area is still bearing forest which would even now be more productive if tilled. But the tendency, under private competition, is everywhere to push the forest back upon what at the given time constitutes absolute forest land, or else to destroy the woods altogether. The question now arises: Will the permanent needs of this country be subserved by restricting forests to lands of this character?

One must bear in mind that the world is not now, and shows no indication of becoming within a reasonable time, a national or economic unit. The people and government of each country

must therefore shape their policy with regard to their internal conditions and interests. Now it may well be that taking the world as a unit, there may be, practically forever, enough absolute forest land to supply everybody with timber without encroaching on a single acre of farming area. Moreover, it will be probably a long time before the intensity of agriculture all over the globe has increased sufficiently to make material inroads upon the great body of what may constitute absolute forest land, according to present economic circumstances. But in many individual countries the facts are different.

In the United States the lands which, at the present time and looking into the future for one or two generations, may be fairly claimed as absolute forest land, consist of the following classes: The steeper slopes and the plateaus of the higher altitudes within the Appalachian system; the mountains of the West, so far as they are climatically capable of tree growth; considerable areas of sandy, boggy, hilly or otherwise infertile soil in the Central West, and the Atlantic Coastal Plain. In many regions the area of forest land is almost continuous, with only here and there a little tract of farm land interspersed. Elsewhere the conditions are reversed. Little islands of untillable land are enclosed by wide stretches of agricultural country. There can be no doubt that under existing conditions of population these lands, if they were all stocked with prosperous forest, would be entirely sufficient for all our needs and even leave a surplus for exportation. At present, not all of it is so stocked, much being brush land of little value. But if we assume that all of it will in the future be brought under productive forestry, this objection will disappear.

However, there are a number of considerations making it improbable that the absolute forest land of the country will be forever adequate to the needs of the people, so that no agricultural land need be encroached upon. In the first place, we have already seen that a part of it will be capable enough of agriculture as soon as a little more intensive methods shall have become profitable. The sandy areas, for instance, could be made fairly productive by farming on a large scale and the application of considerable capital. Lands no better than these are farmed at a reasonable profit in Brandenburg and other parts of Northern Germany. For a long time to come such enterprises will be unat-

tractive to Americans. But with increased population and greater relative abundance of capital the time will surely come when such lands will be as truly agricultural here as in older countries.

It is altogether likely then, that with advancing economic development the extent of absolute forest land will be reduced far below the twenty-five per cent. of total land area that is roughly assumed to be the proper proportion. When this high development is reached, such lands will be confined to tracts so steep and rocky that plowing or even hoeing is out of the question, and to a narrow strip in the mountains between the upper limit of agriculture and timber line.

But another fact must not be lost sight of. Trees no more than agricultural plants reach their best development on poor soil. The tracts ultimately left as absolute will be, almost without exception, among the poorest site classes, where neither a profitable rate of growth nor good quality can be expected. Even at the present time it is not safe to give up all agricultural areas if the forests of the future are to be good ones. For instance, it is now assumed without discussion that in the Lake States clay lands are to be left to the settler. Only the sandy tracts, the "pineries," are claimed by the forestry advocates. But it is a fact that the best white pine never grew in the pineries, not even in the least sandy of them. The great "cork pines," which furnished the last generation with an abundance of the splendid, clear white pine timber that has now practically disappeared from the market, came from the clay lands. On the sandy areas the trees never reached great size, although the rings on the stumps tell us that their age was respectable enough. It is very probable that the rate of growth in such situations is not sufficient to make re-growth profitable from the purely financial standpoint. Furthermore, are we to confine ourselves altogether to species capable of growing on the poorer lands? Then how about such valuable species as sugar maple, or tulip tree? We cannot escape the conclusion that if our policy is to be a rigid confinement to absolute forest land the forestry of the future will be seriously handicapped.

This is a matter to be well considered by all who are in any way responsible for the shaping of land and forest policies, either under the federal government or the several States. The cry

about agricultural lands not being needed is very helpful in overcoming opposition to forest reservations in the initial stages and as long as settlement is still in active progress. But by giving way too much in this respect great future embarrassment may be caused. It will of course be exceedingly difficult to regain, for forestry, lands of fair quality after they have once been cleared and cultivated.

ERNEST BRUNCKEN.

CALIFORNIA RED FIR IN THE TAHOE FOREST RESERVE.

California Red Fir (*Abies magnifica*) or Shasta Fir is often confused with the true Red Fir, by botanists called Douglas Spruce (*Pseudotsuga taxifolia*). The common name, California Red Fir is given to the tree from the dark-red color of the inner bark as distinguished from the white inner bark of the White Fir (*Abies concolor*). The range and habitat serve to further distinguish these two species. California Red Fir occurs on slopes in the high Sierras in almost pure stands. Douglas Spruce is chiefly found in the Coast Range, and as scattered individuals along the river courses of the lower Sierras, and is not an associate of the other species.

California Red Fir is rapidly becoming of economic importance in the northern Sierras, the more so as the pine becomes exhausted. It presents a problem in forest management distinct from that of pine because of the different silvical characteristics. The following observations apply to this species as found in the Tahoe Forest Reserve, California:

Botanical Characteristics.

This species is closely allied to White Fir (*Abies concolor*) from which it is distinguished by its dark-red brown, ridgy bark, on the older trees 4-6 inches thick; by its erect, incurved, four-sided leaves crowded against the stem, completely hiding the upper side of the branch; and by its oblong cylindrical cones, 6-9 inches long, of a dark purplish brown color. Like those of all true firs the cones stand erect on the ends of the branches, the scales falling from the axes at maturity.

The trees bud in May, flower in June and mature their cones about the middle of October. In the Lake Tahoe region the average height is over 120 feet, the maximum 150 feet, average diameter 30 inches, maximum 6 feet. The taper is rapid, there being an average of from 3 to 5 logs to a tree. The trunk is symmetrical and clears itself at an early age, the clear length being much greater than in White Fir. The crown is occasionally flat

in old trees, but the younger trees have graceful, spire-like tops with branches extending at regular intervals from the trunk, giving the foliage a compact appearance.

The shape of the butts is peculiar, buttressed and flaring, showing their adaptation for withstanding the pressure of snow, especially in those on the slopes. The root-system is strong from the need of the location, the untoward conditions having brought about the survival of the fittest, all the weaker trees being uprooted or broken down by wind and snow.

Habitat.

The Red Fir occurs as a rule in damp, sheltered situations of eastern and northern slopes, at an elevation of 6,500 feet or more. It reaches its best development in a fairly deep soil derived from disintegrated rocks, and containing a fair amount of humus. It will grow on a rocky soil, but here is noticeably unsound and scrubby. Light is apparently required at all periods of life, the tolerance not being as great as that of *Abies concolor*. The tendency of the seedlings to come in by groups has brought about even-aged bunches of young growth in a stand which is chiefly composed of mature uneven-aged trees.

Associated Species.

At the lower limit of distribution the common associate is White Fir, but above 6,500 feet the stand becomes composed chiefly of Red Fir with a few hemlocks (*Tsuga mertensiana*) and Silver Pine (*Pinus monticola*) intermixed. The stand can be said to be 95 per cent. Red Fir and 5 per cent. of the other two species. In the gulleys and along stream courses, at an elevation of from 7,500-8,000 feet, more Hemlocks and Silver Pine come in, as well as a few Lodgepole Pine (*Pinus murrayana*). Red Fir is rarely associated with Sugar or Yellow Pine, usually occupying situations above the range of these two species.

Reproduction.

Reproduction occurs chiefly in bunches in depressions or benches where there is abundant light. It is sparse on slopes where snow-slides combined with the short length of the vegetative season prevent it from getting a foothold. In the summer of

1906, for instance, the snow did not go off these slopes until the last of July, and came again the middle of November. Except in gulleys where hemlock has come in, the seedlings found on the Red Fir type are almost entirely of that species. The few Silver Pine seedlings which occur are destined to vanish in the future composition of the stand by suppression.

The seeds, which are dark-reddish brown, fall in October, but do not germinate as a rule until the following spring, owing to the frozen condition of the ground. The growth of the seedlings is exceedingly slow at first. They are often distorted by the snow, but show ability to recover from the hard times, and develop into thrifty trees after the slow-growing period has passed, and they enter upon the middle period with the most rapid rate of growth.

The seed is borne prolifically every other year, although some cones are borne each year, as in all firs, generally appearing in the tops of the trees. The seeds are insured wide dissemination because of their wings and because of the height from which they fall.

Diseases and Enemies.

The trees on more level ground show the best condition of health. Those on the slopes in many cases have their butts injured by snow slides, and although they do not become unsound as quickly as does the White Fir after being injured, yet most of them require long-butting in logging. Spike tops, caused by wind or snow, are common, but unless a tree is very badly affected otherwise, spike-tops will not destroy its usefulness for lumber.

The waste due to defective trees is ten per cent. in Red Fir, as contrasted with 50 per cent. in White Fir.

Defective butts make the trees liable to wind-throw, but it is not often that uprooting takes place. Injury from fire is not severe, owing to the thick bark on the older trees. Insects or mistletoe (*Arceuthobium occidentale*) do not injure the Red Fir to any appreciable extent.

Commercial Value.

Red Fir lumber closely resembles that of White Fir, and is used for much the same purposes. Very little of it has been cut until recently because of the lack of demand. This, together with

the high altitude at which it is found, did not offer any inducement to the lumbermen to log it. The opening of the mines in Nevada has created a demand for Red Fir, however, and it commands a price very nearly equal to that of pine. Besides being valuable for lumber, it is used for pulp and will be of much importance in the future development of the paper industry on the Coast.

Considerations in Marking for Cutting.

Red Fir, even though it has defects which would render White Fir (*Abies concolor*) unfit for lumber, will be found merchantable. Spike-tops, defective butts, and cancerous-looking growths are no indication that the trees contain no merchantable lumber. Such trees on being felled often contain several logs free from defects. No dead fir, however, should be marked for cutting, although recent wind-falls contain sound logs and should be taken. Hemlock and Silver Pine should be marked irrespective of defect, providing there is one merchantable log in the tree.

Taken as a whole, the Red Fir type presents a uniformly healthy condition. Counts show the condition of health to be as follows:

	Thrifty.	*Mature.*	*Decadent.*	*Dead.*
		Per Cent.		
Red Fir, ...	40	30	25	5
Hemlock, ...	91	5	3	1
Silver Pine, ...	85	5	8	2

Defects are not caused, as a rule, by fire or insects, but by snow. Its weight breaks the tops and branches, giving fungus-spores easy access. Spike-tops often result from wind-break or lightning, an old stand presenting a ragged appearance by the irregularity of the crowns.

The group system with modifications is deemed the best suited to the Red Fir type. In marking for cutting, there are four paramount considerations to be kept in mind. 1. To afford protection against wind-throw; 2. To retard snowslides on steep slopes; 3. To insure abundant seeding; 4. To leave a nucleus for a future crop.

Protection Against Wind-throw.

Comparatively few trees are uprooted by the wind in closed stands, but it is very probable that the opening up of such stands

would result in wind-throw. The tall, slender trees which have always been protected by the closeness to their neighbors, would be the first to feel the force of the wind. The leaving of groups stands are uneven-aged, yet bunches of young trees frequently of young trees in exposed situations, lessens this danger. The alternate with bunches of mature timber, an ideal condition for the operation of the group system.

Young trees which would be isolated by the removal of surrounding mature trees that had afforded them protection, and permitted the attainment of tall, cylindrical boles, and a superficial root-system, should not be left to the mercy of the wind. It is only when compact bunches, the members of which afforded each other mutual protection, are found, that trees of this character can be left. Only trees that are wind-firm, such as those on exposed points, should be left. These trees have demonstrated their ability to withstand the stress of the elements, their root systems having become developed to meet the strain.

When the removal of mature or defective trees endangers the compactness of a group of young trees, such trees should be left. In marking, it is not uncommon to leave trees up to four feet in diameter when it is thought that their removal will open up a neighboring group of young trees and nullify the purpose for which they are left.

Retardation of Snow on Steep Slopes.

Especial care should be taken in marking timber on steep slopes where danger from snow-slides is great. Owing to the rocky nature of the soil on which this type occurs, the danger from landslide is not a consideration even after the timber is removed. It is noteworthy, however, that young growth is conspicuously absent on the steep slopes where the openness of the stand permits snow-slides. The young seedlings are torn from their slender foothold by the moving masses of snow, or so badly injured that they do not recover.

There is generally snow in the high altitudes in which Red Fir flourishes at or soon after the time of seeding. The seeds are carried by the snow or washed down by the rains, to find lodgment in the more level places. The density of reproduction in such places is in marked contrast to the nearly barren slopes above.

The snow is on the ground from November until June or later, allowing the seedling but a short vegetative season. Consequently, the growth is slow and is further retarded by the weight of snow which causes the development of the curved bases so universally found in fir growing on slopes in high altitudes.

In guarding against the baring of slopes by snow-slides it is essential to leave bunches of strategically placed trees. Wherever possible, strips of young timber, extending from the base of the slope to the crest should be left, the continuous line forming a more effective barrier than isolated bunches scattered at irregular intervals. All thrifty trees, isolated or in bunches, should be left on the crests of slopes to protect them from the snow which would drift from the benches above. The young growth in ravines and on benches requires no protection by selective marking inasmuch as the question of snow-slide does not enter into consideration here.

The buttressed butts of the trees on the slopes show their adaptability to withstand snow pressure. These curved bases necessitate long butting in logging operations as well as the cutting of high stumps. Defective butts, caused by the barking occasioned by dislodged boulders are common on slopes. Debris, lodged against the upper sides of the butts of trees, when burning, causes extensive fire scars. These weakened butts make the tree liable to wind-throw and offer easy access to insects and fungi. Such trees should be marked for cutting, when their removal will not be detrimental to the continuity of the strips left for protective purposes.

Insurance of Abundant Seeding.

Judging from the amount of reproduction in the Red Fir type, there is no doubt but that the opening up of the forest will result in a prolific stand of seedlings. *Abies magnifica*, although not as tolerant as *concolor*, is exceedingly hardy when once established. As stated, seedlings occur in groups as a rule, coming in where there is abundant light. The removal of all timber except that in the groups will give this species a chance to occupy the ground to the almost total exclusion of any other species. The few Hemlock and Silver Pine seedlings cannot compete with Red Fir in its characteristic situations because of the close relation of

the factors of the locality to the laws of growth governing the latter species.

Thrifty Hemlock and Silver Pine when found mixed with Red Fir should be left, inasmuch as these species occupy situations not especially adapted to fir. Hemlock is found chiefly in sheltered ravines where the shade is too dense for fir. Silver Pine, because of its intolerance, needs no consideration in marking, as it could not compete with the fir even though favored, because of the admax type in the belt which it occupies, and never reverts to any verse conditions working against it. The Red Fir type is the cliextent because of the inability of associated species to assume its place. This fact is a great help in marking, as the certainty of the future dominant species is known.

Leaving the Nucleus of a Future Crop.

The consideration of a future crop is of great importance in marking Red Fir. This species is destined to form an important item in the economic development of the region in which it grows. It is becoming recognized as valuable for pulp, a mill at Foriston, California, using it exclusively for the making of a high grade of paper. This mill is buying fir wherever it can get it. Millions of feet a few years ago considered practically worthless, are now coming on the market for pulp. During the past summer a large sale was made on the Tahoe Forest Reserve for saw timber, the lumber finding a ready market in Nevada. The mines use fir poles extensively while the lumber brings nearly as high a price as pine. A box factory at Truckee, California, uses fir exclusively in making cracker boxes, and it will be only a short time until many other classes of boxes will be made from it. If treated, fir would be valuable for ties, posts and poles. It is very evident that fir is destined to take the place of pine in the northern Sierras at the rate pine is being cut at present.

In view of the certain demand for fir timber and the increased stumpage value which will ensue, the cut should be made as light as is consistent with the character of the stand. In a tract recently marked, about 10 per cent. of the stand was left, this nucleus being considered sufficient to insure a future crop.

M. B. Pratt.

SCALING GOVERNMENT TIMBER.

When the Forest Service was given control of the National Forests, on January 1, 1905, one of the many problems presented was the accurate and practical scaling of all logs sold in public timber sales. Very few of the Forest Supervisors or rangers who had served under the General Land Office had had experience along these lines of work, since timber had been sold to only a very limited extent and it is doubtful if accurate scaling was thought of much importance.

The Forest Service has solved the problem by employing practical woodsmen (assistant lumbermen and expert scalers) of experience, whose duty it has been to start all big timber sales and aid and train the technical assistants and rangers in the Government supervision of logging. I, for one, fully appreciate the wisdom and necessity for this training. No matter how well the young technical man knows logging, he is sure to have trouble with lumber companies in starting a new scale. The very rules he has difficulty in enforcing, the practical woodsman can put into effect without friction, just because he is known to have had a lot of practical experience.

The scaling of the logs, is of course, by far the most important item in the management of a sale. The difference between a close accurate scale and an ignorant one, may easily amount to from $4,000 to $6,000 in a thirty million foot sale. It is no exaggeration to say that on the San Francisco National Forest the expert scaler saved the Forest Service from $5,000 to $10,000 during the past year and a half, by the system of scaling which he inaugurated. Many of the lumbermen have styled the Government scale as "penurious," but on the whole it has been fair, if it is based on the correct policy. Whether the scale should aim to include merchantable Mill Culls, or whether the basis should be all grades above Second Common (and Box) is a vital question that must be answered before unsound logs can be scaled with intelligence. At present on this National Forest, the official scale includes the "better grade of Mill Culls," and I believe that most rangers scale an unsound log (using the Scribner decimal rule),

on the basis of having their scale hold out, instead of having it overrun by the same per cent. as do sound logs. On the whole my impression is, that if anything, the scale should be made a trifle more lenient. To conform to the standards throughout the country, I personally feel that culls (mill culls and shipping culls) should not be scaled and that the Government scale should overrun on unsound logs in the same ratio as if they were sound (perhaps 12 per cent. with the Scribner decimal C rule). Whatever method is used there will be no great loss, since the stumpage price will usually adjust itself to a "hard" or "easy" scale.

Before a ranger is allowed to scale officially, he is given a thorough training by the expert scaler, and then, when he scales on a timber sale his work is checked once a week on at least 100 logs. If the total differs more than about 2 per cent., his methods are more closely scrutinized and his mistakes corrected. If he cannot keep within 2 per cent. of the official check scaler after being given a thorough trial, he is put on some other kind of work. This involves the Government in considerable extra expense, but the aim is to give the purchaser a fair scale no matter if it does cost more. Usually, in making a check scale the logs are taken as they come. Personally, I prefer to check a definite percentage of sound and unsound logs—say 50 per cent. of each. The check of the sound logs only deals with the scaler's honesty and his ability to read the rule, while a check of the unsound logs hits the vital point,—his *judgment*. If only 5 or 10 per cent. of the logs checked are unsound, a poor scaler might not be corrected for some time.

While most foresters in the United States are no doubt familiar with the details of the Government methods of handling the scale, yet there may be some steps which are in use only on this Forest (San Francisco) that may be interesting, especially to officers in the Southwest. Lumbermen and especially future purchasers of stumpage will be benefited by first understanding what "they will be up against." The work naturally divides itself into (1) a clerical and (2) a practical side.

Clerical.—Each log is marked (by soft black crayon) with a serial number (1 to 10,000) and book letter on the small or scaling end, and the section number on the big end. A scale book (100 pages for 100 logs each) shows the serial number, length, and actual scale of each log tallied. The first book in a sale is

lettered "A" and so on until the alphabet is exhausted, when "a," "b," etc., may be used. Where there are a very large number of logs and the country is not sectionized, but merely divided into lumbering compartments or watersheds, a new alphabet and series of books may be begun for each compartment. Each page has blanks for the section, township, range (or compartment if country is not surveyed), date, where scaled (at the railroad or in the woods), purchaser, timber sale and end mark. Each page also shows the total for each column, for the page, total since the last weekly report and the total cut in the sale. A weekly scale card report (see form below) is sent the officer in charge at the end

WEEKLY SCALE CARD.

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Form 606

Scale Report No. ..... For week ending....., 190....

Purchaser..... Scaled by.....

Contractor..... Landed..... .....

Compartment..... Sec....., T....., R..... End Mark.... Book.....

Species	Number of Pieces			Feet B. M.		
	Scaled in week	Previously rep'd	Total	Scale for week	Previously rep'd	Total
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....

This report must be made out at the close of each week and forwarded to the Supervisor. A duplicate copy should be retained by the scaler. (Over)

(Reverse of above card.)

Remarks

Cut for week : dry, 1950, green, 220490

of each week, including the last even hundred logs scaled. A copy of this report is then approved and mailed to the purchaser. Since all timber must be paid for before it is cut, it is important that these weekly statements be forwarded promptly and a call for further payments made (usually in installments of $5,000 in large sales) if the value cut approaches the value paid for. When a scale book is completed it is sent the local office and the purchaser (or his duly authorized agent) has a right to inspect it in the presence of the forest officer in charge of the National Forest or an inspector, and copy such portions as he desires for comparison. The Government does not furnish a duplicate detailed scale other than this. If a company wishes to "get a line" on the scaling they can keep their own scale of each log and then later make the comparison. One company on this Forest is now making a test on the scaler by this method.

In 1905, on the first sale made by the Forest Service here, the ranger was instructed to put the actual scale and the amount allowed for defect on the end of each log. The result was rather unsatisfactory. Whenever he had allowed too little for defect he

was called to the mill and shown his mistake. Whenever he allowed too much nothing was said. The result was a lowering of the Government scale, until the "game" was detected. Whether the inspection of the detailed scale books will tend to a similar result cannot be predicted. These intricate clerical methods are designed to give inspectors or "check scalers" a chance to verify the accuracy and honesty of all the work done by Government scalers. On this Forest each dead log is marked with a cross in the scale book and the weekly report shows the amount of "dead*" and "green" timber scaled during the week. In addition, special notes are kept in the column headed "remarks," of skids, sway bars, etc., cut and scaled.

To insure the accuracy of all figures, each week's figures are added by two men and both their names should appear on the weekly report. As a further check this office has sent the scale books to Washington to be checked by comptometer. I believe that the Government owes it to all large purchasers of timber, to have the records officially checked once or twice a year and at the end of a sale. Mistakes are bound to occur, and it seems to me to be preferable to have a periodical check of all figures, rather than to have the books checked as they are completed. It increases the office detail (which is too large already) to be continually correcting small mistakes, often of a few feet, which have occurred in the past and which I fear will occur in the future, no matter how carefully guarded against.

The Practical Side.—Scaling costs the Government about $0.15 per M., and where a regular check scaler is employed it costs 5 cents per M. extra. Of course these figures vary from month to month according to the cut. The scalers are paid $80 to $100 per month. The scale rule used is the Scribner Decimal C rule, giving values for 6, 8, 10, 12, 14 and 16 foot logs to the nearest tenth: (*i. e.* 103 board feet is given 100 on the rule). An 18 foot log is scaled as two logs; a top log of 8 feet in length and a second log of 10 feet. The shorter log is always scaled by the actual top diameter. While the scaler may use his judgment on the taper to be allowed for the second log, it has been customary here

* In western yellow pine, the cut of dead is 1½ to 3½ per cent of the green.

to increase the diameter of the log one inch, although the writer has at times used calipers and taken the exact "rise." It is a simple matter to construct a table of "rises" for any species or locality. Scaling logs over 16 feet as two logs on a test case (where 15 to 17 per cent. of the logs were over 16 feet) increased the scale by about 1½ per cent. The diameter is usually measured twice and the average taken. Some men "give and take" on the nearest figure on the rule while others (preferably on account of check scaling) give the average of the two scale readings.

In the actual scaling of partially unsound logs (usually all the logs that scale 1/3 the full scale must be logged, with variations depending on the length of haul, etc.), and the allowance for defect by docking the straight and sound scale, a detailed knowledge of how the logs saw out at the mill, is of course absolutely necessary. In addition to the thorough training with the expert scaler, each scaler is expected to study logs that are being sawed at the mill and if possible check his scale on unsound logs by tallying the boards cut. Unfortunately the men have been too busy and the force too small to allow enough of this practical sort of work.

All contracts on this Forest require that tops be cut to 8 inches inside bark where merchantable, and it is usually "up to" one of the scalers (if he scales in the woods instead of the landing) to see that this rule is being enforced. Cutting to an 8-inch limit inside bark is only required where the top is reasonably straight and merchantable, so it often happens that the average actual top limit is 9, 10, or even 11 inches. Whether to strictly enforce a rule of this kind is a problem. On account of the rapid taper in the western yellow pine it often happens that the scale is as large and sometimes larger if the top log is cut two or even four feet shorter on account of the increase in scaling diameter. For example it is often a question between scaling a 16-foot log, 8 inches at the small end, or a 14-foot log, 9 inches, which gives the same scale in either case. Cutting the shorter logs and not having to do much trimming work saves money for the company, although if they do their own brush piling it is just so much work accomplished.

When defect appears in the end of a log its size is measured and the scaler deducts roughly according to whether it can be eliminated by a 4x4, 6x6, 8x8, etc., taking into consideration

whether the defect runs straight through the log or is irregular. If the ordinary rot appears at one end of the log and not at the other it is considered as running half way through unless loose knots show positively where the defect started. In his book entitled "Forest Mensuration," page 71, Professor Henry S. Graves gives a table showing the amount to be deducted for defects of different sizes. The figures for 16-foot logs are given below and although they seem a trifle too liberal, they can be used as a guide. They should not be used literally, but should merely be made a basis for calculating the rot.

Loss by Defects of Different Diameters Near the Center of Logs.

Diameter of defect inches	16 foot logs loss board feet
2	8
3	15
4	23
5	32
6	44
7	57
8	72
9	89
10	107
11	128
12	151
13	175
14	200
15	226

A large per cent. of the logs are defective, and certain kinds of defects are met with which, with slight variations, may be scaled on a fairly uniform basis. Ground rot, for example, rarely extends into the butt log more than four feet. "Peckiness," though unsightly, will often grade into merchantable mill or shipping culls. Fire scars do not affect the scale as much as they apparently do, since after the log is slabbed, they disappear entirely. No allowance need be made for blueing due to lightning, unless soft rot has set in. This is, of course, on the basis that all merchantable mill culls are to be scaled. Special care should be taken in allowing for "winding" defects, which of course cause more of a shrinkage than when straight. When a log is both crooked and defective a larger allowance should be made. Although theoretically the only difference would be short boards, yet practically there is a much larger waste in sawing. Crook in butt logs must be allowed for, but in the species here under con-

sideration, it is usually the fault of the sawyers, if the other logs are not sawed so as to eliminate the crook. Dead logs are always scaled rather liberally. Where the sap has become defective the heart of the dead log is scaled as though it were a sound log. Where there is rot in a dead log, a much larger per cent. (about 25 per cent.) should be allowed for rot than if green, since there will always be a great loss on account of the brittle character of the wood when it has been dry for a long time. Where a dead log is badly checked to the heart it is usually unsuitable for merchantable timber.

Mature men make the best scalers and it is absolutely necessary that they know the *species* they are scaling. The men here have had it impressed upon them so frequently that they must be "silent scalers" and not discuss or argue about individual logs that quite an air of mystery has arisen regarding the Government scale. This is not necessary and the more outsiders know about the careful methods employed, the better it will be. I know the aim of all the scalers is to give the Government and purchaser alike "what is coming to them."

T. S. Woolsey, Jr.

SOME FUNDAMENTAL PRINCIPLES OF SILVICULTURE AS STATED BY PROF. HEINRICH MAYR.*

Of all the branches of forestry, the theory of silviculture or silvics undoubtedly comes closest to being a science in the sense that it is not a mere collection of facts and rules, but establishes relationships and deductions which are true all the world over. Unfortunately there are still many foresters who claim that there is no science in silvics, but only a collection of rules applicable to limited conditions and that, therefore, each country and each region has its own laws of tree growth. Prof. Heinrich Mayr, more than any one else, has helped to dispel this misconception. His intimate acquaintance with the forests of the Old and New World, and his extensive experiments in introducing exotics into his own country have given him a wonderfully rich and varied material upon which to base his observations and conclusions. He has formulated a set of principles which he believes will hold true wherever tree growth occurs. These principles represent the accumulated experience, the crystallized net achievement of many years' observation of tree growth under the most varied conditions of soil and climate.

In this country there is still a vast and practically untouched field of investigation in the life and habits of forest trees. Professor Mayr's fundamental principles should therefore be of especial value to us, because they should help us to orientate ourselves amid the numberless phenomena which our daily observations are continually bringing before us. For this reason it has been determined to make them available to American foresters by the following translation.

R. Zon.
A. T. Boisen.

1. Wherever the average temperature during the four months of the vegetative period is as low as 50° F., the forest becomes scrubby in character, no matter whether this temperature is due to latitude or to altitude. This law is equally true for Europe, Asia, and America, and for the northern and southern hemis-

* From the *Allgemeine Forst-und Jagdzeitung* for 1901.

pheres. At the equator, for instance, the limit of the forest zone occurs at an elevation of about 11,500 feet. At this altitude the average annual temperature and consequently that of the four months of the growing season is 50° F., since the temperature at the equator is uniform throughout the whole year. At this altitude the evergreen broad-leaved forest ends, and soon after, the deciduous broadleaved and coniferous forest which forms its outer fringe, and the chaparral growth begins. Above this, all arborescent vegetation ceases. Within this equatorial forest zone with 50° F., temperatures below 32° F. seldom occur; the forest ends there at an annual temperature at which in Germany the oak forests, the tobacco, and the grape find their optimum. At the equator as well as in the southern hemisphere, the extra eight months with an average temperature of 50° F. do not help in any way the growth of the forest. They are as useless as if they were eight months of cold winter; their only influence is found in the fact that the stunted growth of our latitudes is replaced there by evergreen broad-leaved shrubs. From this follows a physiologically and therefore silviculturally important conclusion that a prolonged low temperature is by no means equivalent to a temperature that is higher but of shorter duration; and that the total amount of heat is not a sufficient criterion for the climatic characteristics of a plant. This conclusion is not without practical interest in solving questions concerning the effects of shading (*e. g.* regeneration under shade, thinnings, etc.).

2. In the whole northern hemisphere wherever there exists an average temperature of 53° to 59° F. during the months of May to August inclusive, there is found a forest vegetation which corresponds closely to our own vegetation with the same average temperature in those months. In other words, if with us under such climatic conditions spruces and firs are found, then in the rest of Europe, America, and Asia, spruce or fir, or both, must predominate. Wherever throughout the northern hemisphere the temperatures of the growing season are the same, the arborescent genera are the same. To similar temperatures throughout the northern hemisphere similar species correspond. It is therefore sufficient to know the temperature for the four months of the growing season to be able to form an idea as to what species are indigenous to it or can be cultivated there. For instance, beech

grows with us as well as in eastern America, and eastern Asia at an average temperature of 59° to 64° F. during the four vegetative months. At such average temperatures during the four vegetative months can be cultivated also all other species of the genus Fagus as well as the species which accompany it, viz. the genera Quercus, Acer, Tilia, Tsuga, Chamaecyparis, etc.

The knowledge of the climatic ranges of the native as well as of the foreign arborescent species is therefore fundamental for their cultivation.

3. Conversely, if we find in a region of the northern hemisphere spruces or beeches or chestnut, etc., we can with the greatest accuracy infer from the original natural occurrence of these species that in this locality the same climate must prevail as in our zone of spruces or beech or chestnut; we can consequently use definite species to determine the climate of a region for which there are no meteorological data at hand. This method may be widely applied because meteorological stations are lacking in many forest regions of Europe and especially of America and Asia.

4. In determining vegetative climatic zones, the species best adapted for this purpose are not annuals or biennials, not the low plants which grow upon or just above the ground, but tree species alone, and of these only such as occur in a limited climatic zone, as, for instance, spruce, beech, chestnut, basswood, and mountain ash. Our pine, for instance, could not serve as an index of climatic conditions because its range extends from the southern limit of the distribution of chestnut on the other side of the Alps, to the northernmost limit of the forest in general, occurring in all the intervening forest zones. Rare species which occur singly, such as Taxus, Pyrus, etc., are also unserviceable.

5. Each species can also be cultivated outside of its natural geographic range (*e. g.*, larch, or *Pinus cembra,* in the north of the Alps), provided special situations are selected for it which possess a climate similar to that of its native home. If the region into which the new species is introduced is cooler than that of the region in which it occurs naturally, it requires warm situations, southern slopes, and consequently drier, and poorer soils; species which are introduced into a region warmer than that in which they occur naturally require cool situations (northern slopes, or

moister soils over which the air is cooler) as in the case of oak, spruce, and larch on the Bavarian plateaus.

6. Where the temperature is favorable, the extension of the range of a species is limited by the soil. From the fact that the situation is warmer, the drier and poorer it is, and cooler the moister it is, it follows that soil is the deciding factor in the adaptability of a species to a new region, in which the temperatures correspond to those of the natural range of the species.

7. Where the soil conditions are favorable, the extension of the range of a species is limited by the climate; for instance, spruce and larch in the lowlands, oak, walnut, in the cooler situations of Germany.

8. By silvicultural methods like shading and thinning, we are able to change light conditions and consequently temperature conditions to a perceptible degree. The further we depart in the cultivation of a species from its native climate, the more difficult its cultivation becomes, because of the diminution of natural reproduction, the need of greater protection against frost and drouth, and the great change in its light requirements. The species disappears from such situations as soon as man withdraws his hand.

9. From paragraphs 5, 6, 7, and 8, it follows that there is no such thing as adaptation of an arborescent species to a climate radically different from that of its native range. The whole silvicultural practice in the raising of native species as well as experiments upon exotics tends to prove this. Since no perceptible change in the temperature requirements of species has taken place for centuries (*e. g.* the native walnut and black locust) it is justifiable to say that for practical purposes there does not exist any acclimatization of tree species. In those cases where acclimatization of species has been generally thought to exist, it has been found that the climate did not differ essentially from that of the native habitat of the species, and when the climate did differ essentially there was no adaptation.

10. Since trees grown in the coolest situations do not acquire any special power to resist frost and trees grown in the warmest situations do not become for this reason especially sensitive to frost, but each individual is capable of thriving equally well in the coolest and in the warmest situations within its native range, the

origin of the seed is not of any consequence in determining the climatic requirement of the individual. The origin of the seed no matter whether it is collected in the most northern or the most elevated situations or in the southermost limits of the range of the species is not of any practical consequence in producing hardy or sensitive races.

11. Between heat and light on the one hand, and the quality of the soil on the other, a certain relation exists; the soil requirements of a plant decrease somewhat with a more open stand and on warmer situations, and the reverse is true in a dense stand and on cold situations.

12. There is also a relation between light and temperature requirements. All species are more tolerant in a warmer climate than in their climatic optimum and conversely they require more light in the colder portions of their range. Just as climate has not produced varieties within the species capable of enduring extremes of heat or of cold, just so it has not produced tolerant or intolerant varieties. The same individual which in its climatic optimum may be semi-tolerant (ash, maple, elm, white pine, etc.), in a warmer region becomes *tolerant*, and in a cooler *intolerant;* intolerant species (oak, Scotch pine, etc.), in warmer regions become semi-tolerant; while tolerant species (beech, spruce, fir, etc.), in cooler regions become semi-tolerant or even intolerant.

13. In a level country or in a hilly country with altitudes ranging from 300 to 600 feet, the climatic zones of the tree species tend to follow the parallels. Sea and air currents however, are very important disturbing factors. Thus the climatic zones of the western part of northern and central Europe follow rather the meridians than the parallels. The presence of high mountains, however, produces new vertical vegetative zones, on account of which the recognition of the climatic relations of a species is made more difficult. This is especially true of Germany. If we were to plot the vertical zones according to certain height intervals on an ordinate, and the horizontal zones according to the degree of latitude on the corresponding abscissae, and then connect the zones of like temperature and like species we would find that the same vegetative and climatic zones which occur in the south at higher elevations will be present in the level country in a more northern latitude. Consequently a species whose original

home in the south lies in the mountains may possess a second home in the northern latitudes of the level country. Whether the first and second home of the species is connected (*e. g.* the spruce which extends from the Alps to the Baravian forest, Giant Mountains; Erz Mountains, East Prussia to the west and north of Russia), or whether this connection is lacking (*e. g.* the spruce of the Alps, of the Harz Mountains and of Norway), or whether finally one variety is replaced in the second home by another (*e. g.* the Alpine larch and the larch of northeastern Russia), all depends upon the configuration of the country, on the geological origin of the tree species, and its ability to migrate, etc. From what has been said above, the following lessons may be deduced: Arborescent species occurring in the mountains in the south are not necessarily mountain species. Our European spruce like the Douglas fir of western America is a mountain species for the same reason that it is in the north a species of the plains. The terms "mountain" and " plain" as applied to tree species are not only unscientific but harmful in practice, because they may lead to a wrong conception of the nature of the tree and the method of its cultivation.

14. If the vegetative zone from which a given species has come is known, its climatic requirements are determined closely enough for silvicultural purposes. Where there are no climatic data, the mentioning of the elevation has as little value as the giving of the degree of latitude, which only misleads. In such a case it is preferable to know the latitude and altitude together, although there are but few foresters and horticulturists who would know the climate corresponding to 46° north latitude, and 5,000 feet above sea level (European larch) or the climate of eastern Asia at 38° north latitude and 6,500 feet above sea level (Japanese larch.) But when it is mentioned that both larches grow, in Europe, as well as in Japan, in the zone of the spruces and firs, then every educated forester will know the climatic zone in which these larches have their home.

15. If within the same climatic zone there are two or three species of the same genus, (*e. g.* three species of oak, (Germany), or three species of spruce (Europe), these species did not originally mix with each other, but occurred on distinct situations and under slightly different climatic conditions. Only the silvicul-

tural activity of man has brought together the two most important species of oak, which originally had entirely distinct ranges. The present silvicultural practice does not sufficiently consider these minor climatic peculiarities of each. Still better examples of this principle are furnished, of course, by the American and Japanese forest regions so much richer in species.

16. In the natural mixture those species are generally grouped together, which in their climatic and silvicultural properties stand very close, and in their botanical properties, and, therefore genetically, very far apart (beech-fir, oak-pine, maple-ash-linden).

From Rule 15 it follows naturally that two tree species which in their external characteristics stand so close that systematic botany thinks it necessary to regard them as varieties or even as identical forms must for this very reason be regarded as tree species, because they are geographically separated, and therefore, physiologically (*e. g.* climatic requirements) different.

It is, moreover, not permissible to ascribe morphological variations exclusively to climatic differences, as for example, when it is said that the Russian spruce (*P. obovata*) is merely a climatic form of the German spruce. If the climate were the cause of the variation between the two species of spruce, Russian spruce would be found in the higher Alps, Bavarian Forest, Fichtel Mountains and Harz Mountains, just as well as in Russia, of whose climate we think with horror because and altho we know nothing at all about it.

17. The accurate systematic classification of species is of greatest importance for determining the peculiarities inherent to tree species. In Taxonomy it is therefore extremely undesirable that the classification of species should be made by those who know neither the climatic nor the biological requirements of the tree, or even by those who are not sufficiently prepared for necessary studies of this sort.

18. All injuries to plants by frost, in so far as any part of the plant is killed, are to be attributed directly to the killing of the protoplasm by low temperature. Blackening, browning, and withering are merely the result of this phenomenon. The protoplasm is most sensitive at the time of its greatest activity (cell formation), *i. e.* during the growing season. It is least sensitive in the diluted watery consistency which is found in the periods of

vegetative rest (fall, winter, and early spring). During this time the green colored part of the protoplasm (chlorophyll) is more sensitive than the colorless parts. The browning and shedding of needles during winter is caused by the killing of the chlorophyll through sunlight and low temperature and not by drying and low temperature. The air-dry protoplasm of seeds in their prolonged period of rest is not in the least sensitive to frost.

19. All arborescent species (*e. g.* spruce and fir) transferred from a cool climate into a warmer one, or to exposed situations, suffer from late frosts when the vegetative activity has been stimulated by a previous warm spell, while they are not sensitive to fall and winter frosts. All arborescent species transferred from a warm climate to a cooler one are not sensitive to spring frosts because their vegetative activity begins late, but they suffer from fall and winter frosts, because their vegetative activity ends comparatively late.

20. All silvicultural operations which result in retarding the vegetative activity of a plant (*e. g.* late sowing, transplanting, manuring, late cutting back,) increase the danger from fall and winter frosts.

21. Any individual variations as regards sensitiveness to frost, which occur promiscuously on the warmest and on the coolest situations, are constant only for the given individual, and not for the coming generation. The breeding of species in this direction is therefore impracticable.

22. With increasing age and height, all tree species become less sensitive to frost, not because of adaptation to climate, but simply because they gradually rise from the lower and colder strata of the atmosphere which lie directly above the ground, and because with increase in diameter the tree becomes more independent of the fluctuation in the temperature of the surrounding atmosphere.

23. As the tree grows in diameter its wood begins to play the part of a water reservoir, which makes it more independent of the fluctuations in the moisture contents of the soil and of the atmosphere. This explains why at a greater age the annual increment of a tree remains almost the same from year to year, and the annual layers show a uniformity which contributes much to the technical qualities of the wood.

Atmospheric humidity plays a very important part in the life of the plant and in the management of the forest.

24. Observations which I made at the extreme limits of the forest zone in North America showed me that the limit of the forest lies at a point where the average relative humidity of the air during the four vegetative months falls below 50%. Beyond this limit the forest gradually falls off in height and is gradually replaced by shrubs or by grass prairie.

25. Not all arborescent species indigenous to a forest region extend to this extreme limit of humidity. The forest near this limit consists mainly of oak and 2-and-3-needled pines. With the increase in the humidity of the air the number of species increases (provided, of course, that the temperature is suitable) there appear spruce, fir, 5-needled pines, cedars and others. For this reason broadleaved species as well as 2-and-3-needled pines must be particularly suitable for situations with a low or rapidly changing atmospheric humidity, (for planting in the steppes or waste land, for clear cutting systems, and for forest management in continental climates).

26. An accumulation of trees on a given area and the formation by them of a more or less dense stand tends to increase the humidity of the air beneath the crown cover by a maximum of 10%. The greatest increase is effected by tolerant coniferous species (spruce, fir, hemlock, cedars, Douglas fir, etc.), while pines, larches, etc., and the intolerant broad-leaved species accumulate but a small percentage of humidity. We can merely mention here how important this function of the forest and its composition must be for the existence of the forest wherever an air humidity of 50% for the four vegetative months is approached (*e. g.* the successful growth of artificially established plantations, protection against evaporation from the forest soil, maintenance of springs, etc.).

27. The increase in atmospheric humidity which is found in large bodies of forest acts upon the plant in the same moderating and beneficial manner as the humidity of a sea climate, whose most destructive companion, the wind, is subdued by the forest. Since with the decrease of temperature the atmospheric humidity increases, cold forest regions, (high elevations and northern latitudes) are characterized by a more uniform climate during the vegetative period. As a result of this, the increment although not large, is the same from year to year; the annual rings are narrow and uniform, and wood of the finest technical quality is produced.

28. A high atmospheric humidity facilitates all silvicultural measures (natural as well as artifical reproduction in all its forms). It determines the choice of the method of regeneration, (*e. g.* Schwarzwald, Harz Mountains on the eastern and western slopes) the degree of thinning, etc.

29. Atmospheric humidity apparently favors the formation of better and straighter boles in the pines and in all other species as well (*e. g.* the increase of the straightness of the bole of pine from southwestern Germany to eastern Prussia and western Russia).

30. Atmospheric humidity modifies the demands upon soil moisture in a species. With high atmospheric humidity the species makes less demand upon soil moisture (compare the growth of ashes and alders in southwestern Germany and northwestern Russia).

31. As regards the amount of precipitation during the vegetative period it is known that lack of rain even for a couple of days may be fatal to tender young seedlings. With age and development of the root system, the capacity of the tree to resist drought increases also. A mature tree can withstand a drought of several months' duration with the assistance of its reserve supplies of water. This resistance in old trees is assisted also by the increased surface of crown and bark which absorb atmospheric moisture. If, however, the drought occurs repeatedly during several vegetative periods, and the amount of precipitation during the four months is less than 2 inches, the forest disappears even when the atmospheric humidity is above 50%.

32. Precipitation outside of the vegetative period is especially valuable in wetting the soil thoroughly, because during the vegetative period when the trees are in foliage, the soil seldom receives a thorough wetting. Where the amount of precipitation during the winter is great, or the soil on account of its capillarity, draws moisture from neighboring water reservoirs, (*e. g.* shores of lakes or rivers), the total amount of precipitation for one vegetative period may be even lower than the minimum of 2 inches without detriment to the forest; in such places a forest once established will grow without human assistance (California).

33. A moderate amount of moisture in the soil ("fresh soil") generally improves its quality (spruce on sand). Any further increase in soil moisture, as in moist or wet soils, decreases its

quality. If in the climatic optimum of a species the most favorable soil is a fresh soil, at a higher temperature and a lower relative humidity the soil must be very fresh or moist; at a lower temperature and a higher relative humidity the soil must be moderately fresh or even dry.

34. Deep snow during winter means protection against low temperature in those cases when the plants are covered entirely, but for the tender parts of the plant which project out of the snow, it greatly increases the danger from frost because the air near the surface of the snow in calm clear weather becomes exceedingly cold. The death of such shoots is due entirely to freezing and not to drying. During winters with heavy snowfall the temperatures generally fall much lower than in winters with light snowfall. Winters with heavy snowfall are beneficial to young plants (in middle Europe 20 inches and under-the average maximum depth of the snow), but are injurious to any shoots which project out from the snow; winters with light snow-fall are harmful to low plants (the lowest temperature is directly above the ground) but are beneficial to the taller plants.

35. The direction in which the most dangerous storms move is parallel to the direction of the cyclone or of the barometric low pressures. This direction in Europe is from west to east, in eastern America from east to west,* in eastern Asia from south to north. Less dangerous are the storms traveling in the opposite direction, in Europe the eastern, in America, the western, in Japan, the northern. Of still less danger are the winds from the other direction. Each elevation above the ground produces a deflection of the air current, a whirl-wind whose height is equal to the height of the elevation and which on account of its rotary motion diminishes the force of the wind blowing on the surface of the ground and makes it blow in the opposite direction. For this reason, on the windward side, dangerous winds often arise which in Europe have a direction of east to west, in eastern America from west to east and in Japan from north to south. This fact must be taken into consideration in locating the cutting areas and in all problems of regeneration. Thus in Europe in regenerating

* It is a little hard to see how Prof. Mayr came to this conclusion. The path of the barometric low pressures in eastern America seems to be from west to east. (See Henry's Climatology, p. 14.)

an eastern mountain slope by a system of clear cutting in strips, the strips should run from northeast to southwest, while the cuttings should begin on the nortwestern side and proceed toward the southeast. In Japan under similar conditions, the strips should run from the northwest to southeast, and the cuttings should proceed toward the northeast.

36. Without belittling the influence which the mineral composition of the soil exerts upon the growth and development of tree species, it must be emphasized that in forestry and especially in horticulture the influence of different soil constituents upon the growth of the tree species, even to the point of causing their entire disappearance (a favorite dictum with reference to exotics) is entirely too much exaggerated.

All plants in their youth are very modest in their demands upon the quality of the soil; only as the trees grow older do their demands upon soil become greater.

37. In its climatic optimum each tree species is omnivorous, *i. e.* it can thrive on soil of any geological or mineralogical derivation, provided, its physical condition and mineral composition do not prohibit plant life. With the approach to the limits of heat or of cold for a given climatic region, it becomes more and more necessary for the tree to have a greater amount of certain definite nutritive substances (*e. g.* beech at the northern and southern limits of its range).

38. The greater the difference of climate or treatment from those characteristic of the native home of the plant, the greater is the need of a more careful selection of nutritive substances as well as of the different physical properties of the soil, (*e. g.* park and garden trees and particularly pot plants for which the right selection of soil and its proper physical condition is of the utmost importance). From this it follows that the more the conditions of growth deviate from the natural conditions the less the species is suited for growth in the forest or life in a wild state.

39. Provided the climate is favorable, all plants find the optimum for individual development on so-called normal soils, viz. on soils sufficiently rich in mineral substances, porous, fresh, and deep. When one of these factors is absent, certain species are excluded from the general struggle for existence; only such species enter then into the composition of the forest which have the

greatest adaptability (on poor, loose, dry, and deep soils, pine; on good, loose, but wet soils, alder; on good, loose, moist soils, spruce).

40. The light which is most favorable for the activity of the chlorophyll and consequently for plant growth is reflected light, produced by a sky partly covered by light clouds, and not the direct rays of the sun or the diffused light of cloudy, foggy or rainy days.

41. From this it is clear how various is the influence of shaded plants. This influence in some cases is very favorable; this is the case with the intolerant broad-leaved species whose light crown-cover moderates the direct action of the sun rays, and the resultant heating of the plants, or in case of lateral shading which protects young growth and seedlings. The influence of shading is unfavorable to undergrowth when in a two storied forest the upper story consists of tolerant species.

42. Since in a continental climate the number of cloudless days with strong light and high temperature is generally greater than in an insular climate, and since in a continental climate the increased temperature (southern latitudes, southern exposures, etc.), means at the same time a longer exposure to light and heat while in an insular climate the favorable light conditions decrease the more the temperature decreases, therefore, the effect and the significance of overhead and of lateral shading, of degree of thinning, must be altogether different in a continental climate than in a maritime climate. These silvicultural operations must therefore depend not only upon the tree species, quality of soil, and purpose, but also upon the climate and the prevailing light conditions (exposure, etc.); silviculture must also in this case be guided not by recipes but by the laws of nature.

43. Since Germany in general occupies an intermediate place between the insular climate of western Europe and the continental climate of eastern middle Europe, it possesses the most favorable light conditions for the growth of all tree species; only the southern slopes approach the continental climate, the higher elevation the insular climate; the first because of greater exposure to heat and light, the second because the plants get along entirely without overhead shade, since shade is furnished by the fogs and the in-

creased cloudiness. In the latter case no underplanting and no artificial regeneration of tolerant species is admissible.

44. The true value of the knowledge of the natural laws is shown nowhere more clearly than in those operations which deal with the regeneration of stands, since to choose the right system of management for a stand on a large forest is to solve the problem as to which system of management will secure regeneration most certainly, easily, and quickly.

45. Stands of all species are reproduced most easily at the beginning of their full reproductive maturity, *i. e.* just before they are fully ready to cut. At such an age any form of regeneration or natural reproduction, can be chosen for each species. Financial consideration may, of course, in practice lead to other conclusions in regard to the kind and the time or regeneration, but such practical considerations do not invalidate the correctness of the natural law. They can merely decide as to the expediency of making use of such a natural law.

46. All forms of regeneration are easiest on normal soils and in the climate optimum of the tree species. Towards the warmer regions, tolerance and seed production increase but the relative humidity of the air and freshness of the soil decrease. On account of the greater intensity of light the necessary overhead shading decreases the amount of precipitation which reaches the ground, etc. Towards the cooler climate the humidity of the air and the amount of rain increases, but tolerance and seed production decrease.

47. The regeneration of mixed stands rests on the same natural laws which govern pure stands; the artificial regeneration of mixed stands is more difficult than the natural, since in the former there enters an arbitrary complication of laws and phenomena, whose reciprocal action we do not know. In natural regeneration of mixed stands each stand is divided into as many stands as there are species in the mixed stand. The reproduction takes place therefore at different times for the different species (the division of the regeneration of stands, conceived as pure stands according to time), or the different species are regenerated on different areas (division of regeneration according to space) viz. clumps, when the areas are less than 5 ares groups, when larger than 5 ares, and compartments, when larger than 20 ares

and less than 1 hectar, (*e. g.* selection cuttings, gradual cutting in group cuttings, regeneration cuttings).

48. The smaller the area which is to be regenerated, the greater consideration must be given to the choice of the proper time for commencing the regeneration of the different species the better the chance of beginning regeneration of all species at the same time. The greater the number of species in mixture, the greater the need of choosing for the regeneration of each species separate areas (clumps, groups, compartments) and of beginning the regeneration at different times.

49. In reproducing a mixed stand by individual trees or groups of trees it is necessary first to regenerate the species which is endowed with the greatest tolerance, for instance, first fir and beech, and then spruce, ash, elm, etc. (the order in accordance with the degree of tolerance for the first decade of their life). The regeneration therefore begins with a slight opening up of the crown-cover. Of species with equal tolerance those which have the heaviest seeds and consequently scatter less readily must be regenerated first (*fir,* and spruce; *beech* and fir; *oak* and pine; *beech,* fir and spruce; *beech* and pine, etc.).

The species which is in danger of being over-topped by its neighbors in the third or fourth decade of its life should be reproduced first (*larch* and spruce; *larch* and beech; *beech* and fir; *beech* and spruce).

The foregoing points have no bearing upon the question whether the mixture may not be attained more easily by artificial and natural means at the same time. Thus undoubtedly the mixture of spruce and larch, and of beech and larch can be more easily and quickly affected by combining the two methods of regeneration than by natural regeneration alone, but no one who is unfamiliar with the natural laws of regeneration and mixture of tree species can select the right method of establishing a mixed forest.

50. The best conditions for guarding the forest against dangers of all sorts are: 1, a method of regeneration which resembles most closely natural regeneration; 2, a mixture of tree species which corresponds to the natural mixture, and which is best adapted to the variations of soil and site; 3, a form of management which resembles most closely the virgin forest, (selection sys-

tem). The same conditions answer also all other requirements of forest management and silviculture, viz. the attainment in the shortest time of the greatest amount of wood (volume) of all grades and species and of the best qualities. In the last statement the point in regard to the greatest amount of wood obtained per unit may be disputed. This fact can be determined only by means of experiments and investigation of the increment and profitability of a mixed selection forest.

The more silviculture will rest upon its only true foundation, the laws of nature, the more clearly it will be shown that no other form of management corresponds better to these laws of nature than the selection system, but not that selection system whose chief aim is exploitation alone without thought of the future condition of the forest, but the regulated selection system which takes into consideration the age-classes, and the species, a selection system which does not remove a single tree without taking care of the reproduction and of the future crop. The unregulated selection system is the oldest, the easiest, and the crudest form of forest management, the regulated selection system with its individualization is the most perfect and the most delicate and the most difficult form of forest management and approaches closest to the unattainable ideal.

[The translators have undoubtedly done a good service by bringing this interesting set of statements to the attention of our readers. The careful student of ecology, however, and observer of the behavior of exotics will probably find a number of these "principles," categorically stated as if they were proven beyond peradventure, not supported by his own observations. While Prof. Mayr's statements are most suggestive, and most of them undoubtedly well based, there are some which foresters will do well not to accept without specific verification.—Editor.]

CURRENT LITERATURE.

H. S. GRAVES, *in Charge.*

Quarterly Journal of Forestry, London, England, April, 1907. 202 pp.

Contains a number of short articles dealing with local conditions in Great Britain and India. There is but little in this number of interest to American foresters.

Southern Woodlands, A Journal of Forestry, Lumbering, Wood Manufacture and Related Sciences and Industries. Athens, Ga. 18 pp.

One of the most important steps in the development of forestry in the South is the establishment of a department of forestry at the University of Georgia. Mr. Alfred Akerman, formerly State Forester of Massachusetts, has been appointed the Professor of Forestry and the head of the department. Professor Akerman is in every way fully qualified to undertake this important work. He has already organized a Forestry Association in Georgia and established a journal of forestry entitled "Southern Woodlands, A Journal of Forestry, Lumbering, Wood Manufacture, and Related Sciences and Industries." The first issue appeared in April containing a paper by Professor Akerman entitled "Forest Education," and one by Mr. Alfred Gaskill entitled "Progress of Forestry in the United States." We welcome this magazine and we extend to Professor Akerman and his assistants our hearty congratulations and best wishes for their new undertaking.

Making a Woodlot From Seed. A. Knechtel, Albany, N. Y. 7 pp.

This circular is a concise description of how to raise from the seed chestnut and white pine. Mr. Knechtel covers the whole process of collecting, preserving and sowing the seed, and of setting out the plants. The description is very practical and should be helpful to tree planters in New York.

Fifth Annual Bulletin of the Connecticut Forestry Association. Hartford, Conn., 1907. 56 pp.

This bulletin comprises the proceedings of the Connecticut Forestry Association at the winter meeting in New Haven. The

papers deal for the most part with local conditions in Connecticut and are of value to foresters interested in the southern New England region.

Report of the Connecticut Agricultural Experiment Station for the Year 1906. Part. V. Report of the Station Botanist. 368 pp. Illustrated.

Contains an interesting article on certain fungus diseases, by Dr. G. P. Clinton. Among other diseases are mentioned an interesting leaf blight and rust of pine.

Webster's Foresters' Dairy & Pocket Book for 1907. London, England. Published by William Rider & Son, Ltd.

This is a diary with a large amount of general information of interest to foresters in Great Britain. The information is chiefly of local value.

The Timber Supply of the United States. By R. S. Kellogg. Circular No. 97. U. S. Forest Service. 16 pp.

This circular is designed to call attention to the rapid diminution of our timber supplies. It is chiefly a resumé of statistics, from different sources, of the estimated annual cut and probable amount of standing timber. It does not attempt to give any new facts about the estimated stumpage in the country, but, using old data, draws the conclusion that we are rapidly using up our forest capital and that our annual consumption is about four times as great as the annual increment of our forests. These statistics emphasize our lack of knowledge of the actual amount of available merchantable timber in the country. We hope that the present efforts of the U. S. Bureau of Corporations may receive the support of the country and that a serious census of standing timber may be taken in the near future.

Report of the Michigan Forestry Commission for the Years 1905-1906. Lansing, Michigan. 197 pp. Illustrated.

The most important feature in this bulletin is the biennial report of Professor Filibert Roth, Forest Warden of Michigan. This article is a report of the work done on the State forest re-

serves. The work during the past two years has been mainly along three lines; protection against fire and trespass, reforestation and improvement, and the survey and classification of land. Professor Roth's discussion of the forest fires is of a great deal of interest. It happened that the spring of 1906 was especially difficult on account of the open winter and late spring. The result was special danger from fire. In spite of the difficulty, however, the fires of the spring covered only about 670 acres, or about 1 per cent. of the total area protected; and the total damage amounted to about $700. Under ordinary circumstances the fires would have burned over at least four times the area actually covered. The author estimates that out of every county of 360,000 acres, approximately 15,000 or more is burned off every year, and that for 10 million acres, fully 400,000 acres burn over with a loss of not less than 200 million young trees. Such a loss is indeed appalling and it is a matter of great credit that the Forest Warden has succeeded in making so great a reduction in the damage on the reserves during an exceedingly difficult season. It is a demonstration that fire protection is possible in the Lake States.

It is interesting to note that fire lines are being constructed. This work was begun in 1905 and 30 miles have already been completed. The plan is first to survey and brush out the lines, and then to plow a strip one-half to one rod in width. Such lines cost about $10.00 per mile in the plains and three or four times that much on the higher and rougher ground. The cost of fire protection on the reserves is estimated at two cents per acre for the entire area protected, which certainly is reasonable.

The Forest Warden has established a large nursery and has already begun planting on an extensive scale. In 1904, 51,000 trees were planted; in 1905, 79,000; in 1906, 200,000. Professor Roth is certainly making an excellent beginning in forestry work under exceptionally unfavorable conditions. He is very much to be congratulated.

The bulletin also contains an interesting article by Professor E. E. Bogue, on "Early Harvest Forest Trees." It is interesting to note that he has found the catalpa unsuited to the conditions of southern Michigan.

The remainder of the bulletin comprises short articles on local problems in Michigan and an account of the meeting establishing the Michigan Forestry Association.

H. S. G.

OTHER CURRENT LITERATURE.

The Relation of Forestry to Lumbering. Presented by H. S. Graves at the Second Annual Meeting of Yellow Pine Manufacturers Association. New Orleans, La. January 22 and 23, 1907. 4 pp.

Reasons Why the Constitution of the State of New York Should Not Now be Amended so as to Permit Water Storage in the Adirondack Park. Address of H. S. Graves before Associa- 1907. 1 p.

Value of Swallows as Insect Destroyers. H. W. Henshaw. Circular No. 56, Bureau of Biological Survey, U. S. Dept. of Agriculture. 4 pp.

The Elm Leaf Beetle. W. E. Britton. Bulletin 155, Connecticut Agricultural Experiment Station. New Haven, Conn. 14 pp., illustrated.

Second Biennial Report of the Commissioners of the State Geological and Natural History Survey. 1905-06. Bulletin No. 9, Connecticut. 23 pp.

Forestry: An Exhibition Illustrating the Beauty of the Trees, their Growth, their Cultivation and Preservation, their Usefulness to Man, their Part in Literature and Art. Free Public Library, Newark, N. J. April 12 to May 5, 1907. 11 p.

The Fractional Distillation of Coal-tar Creosote. Arthur L. Dean and Ernest Bateman. Circular No. 80, Forest Service. U. S. Dept. of Agriculture. 31 pp.

Third Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii for the year ending December 31, 1906. Honolulu, H. I. 212 pp.

Report of the Division of Forestry for the year ending December 31, 1906. R. S. Hosmer, Supt. Honolulu, H. I. 137 pp.

Progress Report of Forest Administration in the Andamans, 1905-1906. Calcutta, India. 31 pp.

Forest Products of the United States, 1905. R. S. Kellogg and H. M. Hale. Bulletin No. 74, Forest Service, U. S. Dept. of Agriculture. 69 pp.

Biennial Report of the Register of the State Land Office and Commissioner of Forestry to the Governor, 1904-06. Baton Rouge, La. 21 pp.

A General Consideration of Timber Under Conditions of Modern Demand and Growth. Paper read by Dr. Hermann von Schrenk before New England R. R. Club. February, 1907. 46 pp.

Tupelo: Character, Uses, Treatment. Dr. Hermann von Schrenk. Reprint from "Southern Lumbermen." December 25, 1906. 13 pp.

The Longleaf Pine in the Virgin Forest. A silvical Study. G. Frederick Schwarz. John Wiley & Sons, New York. Illustrated. 135 pp.

Evergreens for the Iowa Planter. Bulletin No. 90, Experiment Station, Iowa State College of Agriculture and the Mechanic Arts. Ames, Iowa. Illustrated. 39 pp.

Farm Forestry. By E. J. Zavitz. Bulletin No. 155, Ontario Dept. of Agriculture. Toronto, Canada. Illustrated. 39 pp.

Sixth Annual Report of the President of the Association for the Protection of the Adirondacks. New York City, April 9, 1907. 30 pp.

Imperial Forest College Rules, Dehra Dun, India. 15 pp.

The Control of Forest Fires at McCloud, California. A. W. Cooper and P. D. Kelleter. Forest Service Circular No. 79, U. S. Department of Agriculture. 16 pp.

Forest Planting in Illinois. R. S. Kellogg. Forest Service Circular No. 81, U. S. Department of Agriculture. 32 pp.

Hardy Catalpa (Catalpa speciosa). Forest Service Circular No. 82, U. S. Department of Agriculture. 8 pp.

White Ash (Fraxinus americana). Forest Service Circular No. 84, U. S. Department of Agriculture. 4 pp.

Public Roads of Texas: Mileage and Expenditures in 1904. Circular No. 85, Office of Public Roads, U. S. Department of Agriculture. 6 pp.

Boxelder (Acer negundo). Forest Service Circular No. 86, U. S. Department of Agriculture. 3 pp.

White Willow (Salix alba). Forest Service Circular No. 87, U. S. Department of Agriculture. 4 pp.

Black Walnut (Juglans nigra). Forest Service Circular No. 88, U. S. Department of Agriculture. 5 pp.

Tamarack (Larix laricina). Forest Service Circular No. 89, U. S. Department of Agriculture. 4 pp.

Osage Orange (Toxylon pomiferum). Forest Service No. 90, U. S. Department of Agriculture. 3 pp.

Coffeetree (Gymnocladus dioicus). Forest Service Circular No. 91, U. S. Department of Agriculture. 4 pp.

Green Ash (Fraxinus lanceolata). Forest Service Circular No. 92, U. S. Department of Agriculture. 4 pp.

Yellow Poplar (Liriodendron tulipifera). Forest Service Circular No. 93, U. S. Department of Agriculture. 4 pp.

Black Cherry (Prunus serotina). Forest Service Circular No. 94, U. S. Department of Agriculture. 3 pp.

Sugar Maple (Acer saccharum). Forest Service Circular No. 95, U. S. Department of Agriculture. 4 pp.

Quantity and Character of Creosote in Well Preserved Timbers. Gellert Alleman. Forest Service Circular No. 98, U. S. Department of Agriculture. 16 pp.

Germination of Pine Seed. Unnumbered Circular of U. S. Forest Service. 12 pp.

Preparation of the Forest Atlas. Unnumbered Circular of the U. S. Forest Service. 4 pp.

PERIODICAL LITERATURE.

In Charge:

Botanical Journals, ... R. T. Fisher
Foreign Journals, ... B. E. Fernow, R. Zon, E. Dunlap
Propagandist Journals, ... H. P. Baker
Trade Journals, ... F. Roth, J. F. Kummel

FOREST GEOGRAPHY AND DESCRIPTION.

Conditions in Northern Europe.

A very interesting report on forest conditions and wood trade in Russia, Finland, Sweden and Norway by an expert forester is published by the German Department of the Interior. The report gives also insight into the silvical changes which similar methods of exploitation as practiced in our country have brought about.

The effect of the Russo-Japanese war had occasioned a depression in export trade which in the years 1904 and 1905 resulted in an estimated decline of 25 million dollars of trade. Now both demand and prices are on the rise. Mills are being moved northward where stumpage is still plentiful and cheap. Swedish sawmill men, especially, are buying logs in northern Finland, where the government owns 80 per cent. of the stumpage, taking them in large rafts along the coast to their mills.

The development of North Russian stumpage is proceeding slowly on account of the unsatisfactory water conditions of the broad rivers (Petchora and Dwina) and the financial trouble of the government, which forbids expenditures for improvement of canals and rivers. A certain district, the Kola peninsula and adjacent territory, accessible to the Baltic, the White and the Arctic Sea, will be most immediately developed.

Small dimension material for mine props, pulp and charcoal wood is being more and more marketed. This demand could be made favorable not only to the pocket of forest owners, but to the growth conditions of their forest, if properly supplied, but it is more likely to lead to devastation. Only 50 years ago spruce in the northern forests had no value; the stout pines alone were cut. As a result the spruce secured preponderance in the composition, and, where not killed by fire, it suppressed gradually the pine.

This change has been often detrimental by changing the soil more and more into swampy conditions, with consequent decrease of increment, and finally moor formation. Large areas of such stagnant spruce moors exist, which, before pine can return, will have to be drained and the spruce removed. Large areas consist of pine and spruce mixed in all stages of transition to spruce forest, where timely reduction of the spruce would re-establish desirable proportions of the mixture. Very large areas consist of natural moors or swamps (as in Canada), which can never produce sizeable material and where, therefore, the utilization of small dimensions is the only rational thing. Unfortunately thrifty young growth in other parts has been largely cut to supply this demand and the government regulations have not been able to prevent it. There is a law, applicable to a large part of Sweden, limiting the diameter to which an owner may cut (the favored 12-inch rule, we believe!), except by permit from a government officer, and export tariffs on mine props and pulp wood exist also.

The effect of this law is double-edged, for it also makes difficult the utilization of minor material in cases where the interest of the forest would be thereby subserved. Hence a large number of competent men are working for the repeal of these laws. For the same reason the foresters in Finland are opposed to the export tariff (of 1/3 cent per cubic foot) on small dimension stuff, inaugurated in 1906, because it hinders the conscientious forest manager more than it prevents the conscienceless forest butcher in squandering his thrifty young stands.

Waldbenutzung und Holzhandel in Nordeuropa in den Jahren 1095/6. Allgemeine Forst u. Jagdzeitung, Feb., 1907, pp. 73/74.

Age, Size and Production in Virgin Forest.

That in Europe giant trees used to exist is attested by some measurements in a Fir forest *(Abies pectinata)* on the slopes of the Emme in Switzerland. Here on five and one-fifth acres old trees, managed in selection forest, have been allowed to grow to ages of over 250 years.

Of the 574 firs, which with 34 spruces and 7 beech, compose the stand (118 trees to the acre), 16 reach diameters over 3 feet and heights of over 130 feet, with 156 reaching diameters of 20 to 36 inches and heights over 118 feet. The average volume

per acre is over 11,000 cubic feet, but the best corner of the oldest trees would measure at a rate of over 27,000 cubic feet.

The tallest tree measures 176 feet, with a diameter of 58 inches and over 1,400 cubic feet in the bole, perfectly sound and clear to about one-half its height, the crown just beginning to round off (cessation of height growth). This tree is estimated from countings on other stumps to be about 300 years old. A companion measures 163 feet height, and 56 inch diameter. Several countings on stumps show the following relations:

Diameter of Stump—inches.	*Annual Rings.*
61	255 (95 years suppressed)
48	280 (105 years suppressed)
38	260
34	275 (several periods of suppression)
30	180
26	130

During the period of suppression the first two trees made only 4- and 8-inch diameter, respectively.

Die grossen Tannen auf Dürsrütti im Emmenthal. Schweizerische Zeitschrift für Forstwesen, March, 1907, p. 77-85.

FOREST BOTANY AND ZOOLOGY.

Climatic Varieties.

That botanical species are not constant in their forms but are subject to continuous changes by mutations, sudden variations and reactions to the factors of environment, is a well accepted fact. The most important of the latter factors are the climatic conditions of the site, which produce morphological and biological variations, so that the same species living under different climatic conditions can be recognized more or less readily as having produced climatic varieties. Plants with short generations can experimentally be varied in a short time, while in nature thousands of years may have been required to produce the variation.

The recognition of the existence of these climatic varieties is of greatest moment to the forest-grower. We have, therefore, briefed the important contribution of Doctor Cieslar on this sub-

ject in another place and under a different heading as a silvicultural subject. Here we brief only the botanical portion of his exposé.

Nobody doubts to-day that the species of trees in regard to biological moments, like rate of growth, time of leafing, of leaf fall, of flowering, habitus, have not always been the same as now. Most of the species have, since the ice age, made wide peregrinations, changing their climate, while also the climate changed in their sites. For Norway Spruce it seems proved that the species in Sweden is still moving southward coming by way of Finland from the continent, while the pine has come from the south. Changed exterior conditions produce morphological and biological variations in the organism and these produce variations in habit which then are acquired ones. The proof that these are acquired characteristics is most readily found by studying them on a species which like the Norway Spruce, ranges from the base of the Alps to the 6,500 foot level. That these acquired habits are inheritable has been asserted by Lamark, and proof of the fact has been furnished from all fields of botany, the most striking of which are rehearsed by Cieslar.

Englemann succeeded by long continued influence of colored light in changing the color of an alga of the genus *Oscillaria* and in propagating this color in the progeny.

Ricinus communis is a woody tree in the tropics, not so the European form, which is an annual and remains so even in the hot house, while the seed from the tropical locality when sown in a hot house produced the woody form, which did not flower until three years old; an intermediate form is found in Egypt (v. Wettstein experiment).

The fungus *Puccinia Smilacearum* was for ten years limited by Klebahn upon *Polygonatum multiflorum* as only host, which weakened its ability to infect its usual hosts *Convallaria majalis*, *Majanthemum bifolium* and *Paris quadrifolia* the stimulus of *Polygonatum* having changed the habit, and the change becoming an inheritance through the spores.

Goebel produced striking changes in the fungus *Micrococcus prodigiosus*, and the changes were the stronger and the more persistent the longer the influential stimuli were continued.

The intermediate forms which are found in nature between two exclusive fields of distribution are also in response to changed

surroundings and their acquired characters become hereditary. The fact that the floras of the seacoast and those of high Alps in all parts of the world bear the same physiognomy and are analogous (convergence phenomena), is also a good proof of adaptations becoming hereditary.

The recognition of the fact of hereditary characteristics due to locality make the question of seed supply one of the most important in forestry.

One of the most interesting generally instructive places for the study of this question is to be found in Vilmorin's testing grounds at Barres, now owned by the French government. Here the genus *Pinus* is represented with 72 species and varieties; *P. silvestris* alone with 30 different numbers, the seed locality of which is known. [See continuation on p. 207.]

Die Bedeütung Klimatischer Varietäten unserer Holzarten für den Waldbau. Centralblatt f. d. g. Forstwesen, Jan., 1907, pp. 1-4.

Winter Period of Trees.

Investigations on 416 species of plants by Howard showed that there is no necessary rest period in growth and respiration. More than half the species investigated budded forth from cut twigs in winter when kept in a temperature of from 15 to 22° C. Others could be forced to do so by various means, like etherizing, frost, drying, keeping dark. The most difficult to induce to sprout were *Carya, Fagus, Fraxinus, Liriodendron, Quercus, Juglans regia.* Twigs of species from the Mediterranean, however, *Buxsus, Ficus,* etc., when transferred from the cold to the hot house did not bud; in these apparently the rest period is fixed.

Jahrbuch für wissenschaftliche Botanik, 1906, p. 516 ff.

Structure and Biology of Roots.

At the meeting of the International Association of Forest Experiment Stations in September, 1906, a program for the study of the structure, growth and physicological functions of roots was proposed, with a view to the use of the information in silviculture.

The investigations are to be made on trees in the open, on bor-

der trees, and trees within stands to find whether differences in structure are produced by different factors, and especially how working the soil to different depths, and various fertilizers and competition with roots of other plants influence root formation.

The period of root growth, the influence of root rot and loss of parts in different soils, the influence of depth to water table or impenetrable strata are also to be investigated.

Fünfte Versammlung des Internationalen Verbandes forstlicher Versuchsanstalten 1906. Centralblatt f. g. d. Forstwesen, Feb., 1907, p. 86.

Fostering of Bird Life.

The value of a bird fauna to counteract insect damage has led one of the leading ornithologists of the world, v. Berlepsch in Thuringia, to develop and observe in their results various devices for fostering bird life. Their construction and their value are discussed in a longer article by Kullmann. The surprisingly favorable results of the systematic protection of birds for a long series of years prove the methods correct and worthy of imitation They are: 1, increase of species and numbers by properly constructed breeding places (as described); 2, construction of brush heaps in open spots for ground breeders, and traps for their enemies, until a breeding shrubbery can be established; 3, feeding birds in winter by specially devised methods; 4, providing water tanks; 5, decimating enemies systematically; 6, co-operation with all neighbors.

Die Berlepschen Vogelschutzbestrebungen. . . . Allgemeine Forst u. Jagdzeitung. Febr., 1907, pp. 50-56.

SOIL, WATER AND CLIMATE.

Humus Formations.

After extensive discussions the International Association of Forest Experiment Stations has adopted a final classification of humus formations for use in forest descriptions, limiting itself to the formations on forest soil. Since the Association has also undertaken to translate its classification

into English and French, in order to secure uniformity of terms we defer the details until that translation materializes.

Fünfte Versammlung des Internationalen Verbandes forstlicher Versuchsanstalten in Würtemberg, 1906. Centralblatt f. d. g. Forstwesen, Feb., 1907, pp. 72-76.

Value of Alpine Bogs.

Bogs covering mountain tops have usually been looked upon as reservoirs holding in themselves the water from heavy rainfalls and doling it out to the soil beneath and to the brooks taking their rise along their lower edges. In the Harz mountains, Kautz reports, the spread of these bogs has been accompanied by severe floods in the streams heading in bogs, which latter are held responsible for the same.

The flow of small streams from the slope just below the bog is intermittent; gullies that remain dry the greater part of the time become torrents after heavy rainstorms. The detritus from the upper slopes near the bog appears scattered far down the river courses but the stones are angular, indicating recent removal from their bed. Since the bog itself is to all appearances and in common report of recent growth, covering soil once occupied by forest growth, it is probably correct to attribute the floods which bore this detritus down stream to the bog itself.

How such results might come from a bog is clearly presented. At all seasons the whole area and depth, possibly excepting a few centimeters at the surface, is saturated with water. Light showers complete the saturation of the surface while heavy storms result in immediate loss of water along the whole lower edge of the sponge-like mass. The water pressure is transmitted more rapidly than the flow over the surface of bare soil would be, resulting in torrents such as have caused the recent floods in the Harz streams.

For control a series of large ditches with moderate grade running along the face of the slope should be provided to carry away the flood waters slowly and to curb the downward extension of the bog. Later remedial measures would look to the drainage of the bog preparatory to planting it to forest as the proper way to permanently hold back the flood waters.

Die Bedeutung der Hochmoore in der Königlichen Oberförsterei Siber im Harz. Zeitschrift für Forst und Jagdwesen: October, 1906, pp. 668-682.

SILVICULTURE, PROTECTION, AND EXTENSION.

Experiences in Seed Testing.

During the seasons 1903 to 1906 inclusive, the fourth to seventh years of its existence, the tree seed testing station at Eberswalde has according to Schwappach made from 150 to 180 odd tests each year, the number rising gradually. Most of the tests were coniferous seeds, Scotch Pine, Norway Spruce, and Larch. The average viability lay near 75 per cent. for the pine, 80 per cent. for the spruce, and 40 per cent for the larch. Special long time tests on White Pine seeds ran through nine months, when 82 per cent. had sprouted. Such protracted tests are no criterion of the value of seeds for planting, and commercial tests are limited to eight weeks' duration. Shortened to this period but 55 per cent. of the White Pine had sprouted, and 50-60 per cent. is about the best that can be expected of this species.

During the early years of the operation of this station methods of testing have been under improvement, results here attained being checked with results from the same seeds tested elsewhere, especially at Zurich. The porcelain dishes used were changed for others free from calcium carbonate, and the temperature was raised from 20° C. to 25° C., these changes giving more uniform results. And lastly the tests are now carried on in the light and not in darkened chambers, for light has a decided influence on the sprouting of some seeds, but apparently not of others. Further it was found that fir seeds sprout better in sand than in dishes and give higher results in autumn than in spring.

The value of seeds from trees of different ages was found to vary. The heaviest seeds came from trees under 50 years old but their viability was low. Again seeds from very old trees—nearly 150 years,—though moderately heavy gave also a low germination per cent. Trees, 80-100 years old, bear seeds of moderate weight but they show the highest viability. Comparative vigor of the seedlings produced from these seeds is now being studied. Darkness of color of pine seeds was found to go with a higher viability agreeing with results obtained in Sweden.

Even when stored most carefully, each year brings depreciation of sprouting per cent., but to an even greater degree lowers the

vigor of seeds, that is, the rapidity with which viable seeds sprout. In two years the number of seeds sprouting in 28 days fell off 60 per cent.

Mitteilungen aus der Prüfungsanstalt für Waldsamen in Eberswalde. Zeitschrift für Forst und Jagdwesen, August, 1906, pp. 505-515.

Test of Pine Seed.

In the very earliest stages of their development seedlings of Scotch Pine show differentiation into clearly marked types characized mainly by the vigor of growth in the root. In seedlings which have the inherent capacity of growing quickly into healthy young trees the root develops first, and attains a length of 1 to 2 centimeters before the cotyledons leave the protection of the seed. This early growth of the root is the only way in which the seedling can permanently care for its own needs.

In testing the viability of seeds between folds of moist flannel Hook found that some seeds merely absorb water, possibly bursting their seed coats but pushing out no growing point. There is no question about their worthlessness. Some, however, go further and send out a root-tip which either remains short and perfectly straight or else twists and bends upon itself again and again as it grows. Occasional monstrosities occur which put forth the cotyledons first, leaving the radicle inclosed in the husk incapable of further development. All such aberrant types of development are to be reckoned as due to worthless seeds. The viability of a sample of seeds is represented by the number of healthy normal seedlings produced. Conditions in the germinating tests are so much more favorable than those met in the seedbeds that individuals at all backward in their development are to be cast out.

Light is of direct influence on germination of Scotch Pine seeds whether it be the bright light of day or that of kerosene lamps, one-fourth to one-half candlepower, 9 feet distant. Unprotected seeds exposed to direct sunlight produce fewer seedlings, which may be due however to unfavorable conditions of transpiration. But in diffuse daylight as with seeds protected by folds of flannel or by a layer of earth the influence of light is beneficial, germination being hastened and the number of healthy seedlings being increased. Unfavorable light conditions thus interfere with the

best development of seeds planted too deeply. As in photosynthesis, so here, too, it is the rays of the left half of the spectrum, the broad red waves, which are potent rather than the chemically active violet rays. Dark colored seeds suffer more than light colored when sprouted in the dark.

Tests in diffuse light give more uniform results though source and intensity must also be considered; artificial light of constant intensity gives most uniform results. The optimum temperature for germinating Scotch Pine seeds is 24° C., but variations of a few degrees are of small importance. Because of the water they evaporate the damp seeds are cooler than the surrounding air, hence it is recommended to keep the germinating chamber at 28° C.

It is of prime importance to know how to interpret germination per cent. figures—to know in what relation indoor results stand to what is attained in the nursery rows. In planting seed of 60 per cent. viability shall we use one and one-half times as much seed as required of 90 per cent. seed? Inquiry reveals that the value of seeds for practical planting falls off much more rapidly than the viability indicates. Of course the seeds must not be mixtures of portions with various viabilities.

Indoor Results.		*Outdoor Results.*	
Viability.	*Vigor.*	*Sprinkled Daily.*	*Unsprinkled.*
95 %	91 %	75 %	39 %
90 "	78 "	63 "	26 "
90 "	57 "	52 "	16 "
84 "	61 "	58 "	18 "
60 "	21 "	25 "	3 "

Another problem is the influence of humidity of the atmosphere in the drying chamber where seeds are extracted from the cones. When seeds are dry and are heated in dry air they may be exposed to a temperature of 80° C. without hurt; but, as they come to the kiln, fresh cones are never dry, and the seeds they contain suffer if heated above 50° C. Just below this point lies the temperature at which kilns for separating Scotch Pine seeds from the cone should be operated. Thorough and vigorous ventilation is of great value in preventing the humidity from rising too high.

Ueber die Keimung und Bewertung des Kiefernsamens nach Keimproben. Zeitschrift für Forst- und Jagdwesen. July, 1906, pp. 441-475.

Importance of Seed Supply.

Dr. Cieslar, the well-known investigator and author, reports in an exceedingly interesting article from the Austrian Experiment Station the results of experiments through 17 years with seeds derived from different localities. [See botanical part on p. 199.]

The species are *Picea excelsa, Pinus silvestris* and *Larix Europaea.* The question which was the object of the experiments was "whether and to what degree the influences of high altitude on the typically decreasing rate of growth and on form, and the characteristic phaenology of the highland trees were hereditary, and what deductions for forestry practice, especially for planting in high and low altitudes the answer involves."

In a preliminary investigation it was found that weight of cone and of seed of spruce decreases in general with the altitude, first more slowly, towards the upper limit more rapidly; and the same change takes place with higher latitudes. In the very first years it was found that both spruce and larch from higher altitudes or latitudes, when planted in lowland situations grow slower than those grown from lowland seed trees, and the larch showed in the first 8 years the peculiar form of crown of the highland trees as well as the late leafing and early leaf fall. The hereditariness of characteristics was unmistakable, and the question was only whether it would continue to show itself.

In addition to the original plantations in 1890 two other series were begun in 1894 and 1896, the one with seed collected from area horizontally very limited, but showing considerable altitudinal variation, the other by planting seeds from different altitudes in different altitudes, one station at 227 m, another at 1380 m, and an intermediate one at 800 m. Altogether 53 sample plots furnish the basis for the tabulations and deductions after respectively 17, 13 and 11 years.

The spruce plantations from seed of lower (below 1000 m) situations not only grew much more rapidly in height, but closed up much more rapidly, a most important point both from the standpoint of soil protection and development of stand, as well as cost of plantation (fewer plants needed). The lowland spruces closed up in 1903-1905, while the highland spruces are still far from closing up. Heights of 112 to 140 cm. compare with heights

of 50 to 75 cm. for highland seedlings and 29 cm. for Swedish seedlings, while those from intermediate elevations run from 70 to 95 cm.

That a change in rate is not soon to be expected is indicated by the trend of the height curves which run still in the same sense in the later as in earlier years.

Most strikingly is this relation exhibited by the plants from seed collected within a narrow horizontal field at 510, 860, and 1140 m, which at 12 years show heights of 110 to 121, 94, and 58 to 59 cm. respectively, the height curves running almost parallel.

An interesting fact was brought out by the unusual summer drouth of 1904. While on the dry soils unsuitable for spruce the lowland plantations lost 20 to 21 per cent., the highland and Swedish plots were almost exterminated, losing 80 and 73 per cent. While the highland spruces have a *relatively* better developed root system, *absolutely* those of the lowland type are stouter and strike deeper, reaching into a more reliable source of water supply.

The experiment of locating plantations at different altitudes showed that the relation of lowland to highland seed supply remained the same, the tallest plants come from lower altitudes, while those from higher altitudes show about half the height growth, and their closing up condition is also as above noted. The author calls attention to the fact that locally favorable situations may occur in high altitudes, and that, therefore, besides the altitude the growth conditions of the stand must not be overlooked, in other words the characteristics of growth in the mother stand will have become hereditary and repeat themselves. The altitude, therefore, also can only be a relative term, for in the southern Alps the spruce finds favorable localities higher up than in the northern (Tirol).

Of other characteristics it was noted that the highland spruces are apt to make double leaders and are many-branched and fuller in foliage. It was determined that in the rapidly growing lowland spruces 1g needles corresponded to 1.646 respectively 1.899g wood, while in the highland spruces this relation remained usually below 1.000g of wood. The question arises whether the assimilation of the latter even at lower levels and under all conditions is slower, than that of the highland type, and whether the same

may not hold true for the transpiration which would account for the death by drouth.

Regarding frost hardiness the following significant remarks are made: "a greater *absolute* frost hardiness cannot be ascribed to the highland spruce; young shoots of either type will be killed with equal assurance by certain temperatures. The *relative* frost hardiness, however, *i. e.* the probability due to time of budding, that a plant with tender shoots will be hit by frost temperature, is *greater* for the northern and highland spruce, planted in lower or more southern situations; because they bud later. The later a plant buds in the spring, the safer in general it is against frost damage because the low temperatures occur more rarely as the season advances; but it may nevertheless happen that an early budding plant escapes on account of the time of occurrence of the frost, which just happens to hit the later comer while the new shoots are still tender.

Silvicultural deductions are made as follows: In lowland plantations it is most advantageous to use seed from a similar locality, which, produces more rapidly growing plants such as can escape the competition with grass, are less likely to be crowded out in mixture with other species, and shorten the period of frost danger because growing quickly out of the frost region. The earlier closing up of such rapidly developing material (8 to 10 years) is a great advantage and will allow a reduction in plant material. Instead of the lately advocated spacing of 4 feet for poor, 5 feet for medium, and 5.5 feet for best soils, the spacing may be enlarged by one foot or so when using thrifty material, and a saving of 20 to 30 per cent. in cost may be effected without danger of delaying the closing up too long.

Plants grown from heavy seed (not less than 10g per 1000 seeds) collected from thrifty lowland growth will repay the trouble of securing it. For planting in high altitudes the highland spruce finds its optimum condition, while the lowland spruce is depressed in its rate and the loss from frost and snow pressure is greater. In the trial plantation at an altitude of 1380 m in a very unfavorable situation the rate of height growth of plant material from lower levels was at first greater than that of highland stock, in the fourth year they were alike, but in the next two years it fell behind. While the plantation of highland stock in

the first six years had lost 20.6 per cent. of the plants; the loss of lowland stock had been 42.7 per cent. The gradual decline of the latter was also noticeable in color and character of foliage, suffering from snow pressure, while the highland stock was most thrifty, so that here also the use of seed from a similar locality is indicated.

But the growing of seedlings for use in such situations should be done in lower altitudes to avoid the difficulties to which in the critical early youth the plants would succumb. [The same could be said regarding growing of stock for our dry plains country.—Rev.]

If grown in nurseries at medium altitudes the seedlings of lowland spruce are retarded in height growth, becoming stockier, and then form most desirable plant material for use in higher altitudes, for they will then not suffer so much from snow-pressure, which otherwise troubles the lowland spruce transplanted into high altitudes.

Comparison with stock from northern seed leads to the conclusion that it is not desirable to use it, for slow growth is its inheritance, and poor root development leads to heaving and loss by drouth.

Experiments with larch, which have been going for 20 years, showed the same relations as those with spruce. The lowland larch produces a better, heavier wood, which is due to more favorable climatic conditions, but this as all the other silvical characteristics are hereditary.

Regarding the behavior of Scotch Pine there are besides the author's series a line of experiments by Dr. Schott which have been taken into consideration.

Northern stock is found to lag behind in increment in every respect in comparison with stock from middle Europe; also shorter needles and lighter wood are typical of it. This retardation of growth of northern stock is also maintained in high altitudes, so that the use of such stock is not advisable anywhere: *seed of home production insures best results.* This has also been proved in Sweden, so that the use of other than Swedish seed is forbidden by the forest administration. The same has been experienced in Finland.

Schott experimented with pine seed from 62 different localities. Great variation was observed in physiological characteristics of

the plants, in budding, flowering time, ripening, and wood growth, form, color, rate of growth. The greater the difference of the regions of supply the more striking the difference in appearance of the plants. The results, after 2 to 3 years only, are formulated as follows:

(a) The pine seedlings from home grown seed are stoutest in growth; they bud early; yearlings are not; two-year-olds hardly affected by "Schütte," and the affected plants recover.

(b) Seeds from North Germany and Belgium furnish similar satisfactory results and produce a very stout root system.

(c) Seeds from northern Russia, Sweden and Norway produce the smallest plants, they bud the earliest, their foliage is thin, increment small. They resist "Schütte" well.

(d) Seedlings from seeds of western Hungary, hill country, remain smaller than the home grown, suffer from "Schütte" much, and form side branches in the fall.

(e) Seedlings grown from southern French seed, mountain country, remain small and succumb to the "Schütte."

The pine being originally endemic in the whole of Southern and Western Europe, had after the ice age been displaced by the deciduous species and crowded to the North East, remaining only in islands in Southern France, Austria-Hungary and South-western Germany. These widely separated, climatically different regions, naturally produced climatic varieties with a number of transition forms. Older authors recognizing these differences have named them e. g. *Pinus silvestris uralensis* Fisch., *P. s. nevadensis* Christ., *P. s. haguenensis* Loud., *P. s. altaica* Ledeb., *P. s. rigensis* Desf.

The deduction is made that pine seed of foreign derivation is not to be used without question. If home grown seed cannot be secured a seed supply should be found which physiologically or biologically promises adaptation to home conditions.

The end result of all these experiences and discussions is, that it is essential in forest planting to *use seeds from localities which climatically correspond closely to the conditions of the locality where the plant material is to be used.*

Die Bedeutung Klimatischer Varietäten unserer Holzarten für den Waldbau. Centralblatt für das gesammte Forstwesen, Jan., Feb., 1907, pp. 1-19, 49-62.

Influence of Seed Supply in Pine.

Similar experience regarding the influence of seed supply to those reported above, have been had with the Scotch Pine. Trials of 22 years' standing at Eberswalde with pine seed from Finland and Norway show at the age of 22 a lower height, by 1 to 1.64 m, a smaller diameter by 1 to 1.8 cm than those from home grown seed.

A plantation of 750 acres made with seed of southern French origin (6500 lbs.) is calculated to have suffered a loss of over $6,000 by reason of slow growth; the difference of three-year olds being in height 65 to 94 : 30 to 49 in needle length 6.9 : 2.4, in favor of the home origin.

It is proposed to institute more complete investigations in this direction.

Fünfte Versammlung des Internationalen Verbandes forstlicher Versuchsanstalten 1906. Centralblatt f. d. g. Forstwesen, Feb., 1907, p. 82/3.

Planting on Heaths.

Forest planting on heath land is always a difficult undertaking because the mineral soil is too poor to support any sort of growth as well as the heath itself which naturally covers it, and because the heath has strengthened its hold immensely by forming above the mineral soil a vegetable soil so rich in humic acids and sour humus constituents that it makes tree growth impossible. Forest planting on heath land is at best difficult and is liable to be very expensive unless intimate knowledge of soil conditions demanded by the species to be planted is used to advantage. The problem is often complicated by the presence at shallow depths of hard pan or bog iron ore.

In any case, according to Greve, the first operation is to burn off the surface with as little injury to the ground cover and vegetable soil as possible. Then the surface of vegetable humus is to be thoroughly mixed with the upper portion of the underlying mineral soil but is under no circumstances to be buried by deep plowing with steam plows. In such burying of the little humus which heath soil contains lies the cause of many failures. Hard pan may be broken when necessary by using a subsoil plow, but this may not be needed. For two years the ground should lie fallow

before a plantation is made; in most cases lupines sowed the second year may profitably increase the nitrogen in the soil. A rolling cutter or Randall (disc) harrow should be used to work the soil and humus together after plowing and before sowing to lupines but the soil is best not broken just before planting. The decayed lupine roots offer openings in the soil along which tree roots find both humus and nitrogen as well as desirable aeration.

Drainage by narrow open ditches is often required before heath land can be reclaimed or even burned over. Scotch Pine is almost alone available for planting but it is doubtful if Pine will supply humus in necessary amounts to the soil. Underplanting with oak or beech is strongly recommended to prevent deterioration of the soil.

Flachbearbeitungs—Verfahren bei Heidaufforstungen. Zeitschrift für Forst- und Jagdwesen, September, 1906, pp. 581-604.

Douglas Fir in Europe.

In a long and lengthy article of 24 double pages John Booth, the owner of the well-known Flottbeck nurseries, sings the praises of Douglas Fir for forest planting in Europe. It was by his influence through Bismark that the German forest administrations were induced to systematically begin the introduction of exotics some 30 years ago. Foresters being naturally and properly conservative, they did not quickly and unconditionally change allegiance to the new introductions, and, being empiricists, raised tenable and untenable objections to the displacement of the native species on a large scale before more of the behavior of the new ones in new surroundings was found out. The same notions or lack of proper notions regarding ecological adaptation, which we have heard discussed in the United States regarding European species prevented a rapid realization of the wishes and hopes of the enthusiastic reformers, who, like Booth, naturally had to take a polemic attitude. Unfortunately most of the experiences regarding the behavior of the exotic species was gained from park specimens and were not convincing to the foresters, while silvical behavior was known only during the early stages.

Booth has here carried together what experiences there have been had with his special favorite, *Pseudotsuga taxifolia.* As is natural, the collection of such statistical data must be one-sided;

failures are not so apt to be recorded, and there are none on record here.

The conclusion from the many (100) exhibits coming from England, France, Belgium, Denmark, various parts of Germany, Switzerland, Italy, is, that in Europe Douglas Fir thrives on almost any soil, from sea shore to Alps, grows much more rapidly (doubly as fast) than any of the native species, has none or hardly any enemies, is more frost-hardy than the native species, and will make surely a wood "which in its poorest quality is equal to the best quality of spruce or fir, and in its best quality is close to larch."

It has sustained this favorable judgment on alluvial sand, sand dunes and pine site of IV class, as well as on the various grades of loamy soils, even in hard and dry soils where spruce succumbs.

The best record as to growth is furnished by the measurements of a 29 year old plantation of somewhat over one acre on Prince Bismarck's own estate. The plantation on loamy sand (spruce III class) was set out one-half with 4 year old Douglas Fir, spaced 4 feet, and one-half with Norway Spruce, spaced 3½ feet square.

The volume of the Douglas Fir at 29 years was 407 fm as against 207 fm for the spruce, or twice as large; the latter ranged from 6 to 16 m in height and 4 to 20 cm in diameter; the Douglas Fir from 8 to 22 m in height and 4 to 32 cm in diameter. A value calculation on the basis of price ruling for spruce, owing to the better dimensions as well as to larger quantity, made the fir around $250 as against $90 for spruce, or nearly three times as large.

Dimensions of older trees up to 70 years—the Douglas Fir was discovered and first seeds imported between 1827 and 1820—show that the same differences of dimensions will be maintained; the oldest on record, between 50 and 70 years, showing diameters of 60 to 96 cm.

[Some peculiar notions regarding climatic adaptations and varieties creep out during the discussion: Frost hardiness seems to be referred to low winter temperatures, not to early and late frosts, and a distinction as to frost resistance is made between the "green" and the "gray" variety. Booth maintains that the "green" variety, which comes from the Pacific Coast, is the "absolutely" frost hardy one. The "gray," slower growing one,

he thinks, has been planted by mistake, and he also holds that there is a great similarity between the *East* American climate and the English and German one. (sic!)

No wonder that such errors and incongruities make the knowing plant ecologist skeptical as to other facts in Mr. Booth's exposition. He should revise his knowledge of zonal distribution by referring to the article on climatic varieties briefed in this issue. We know, the reviewer believes, that Douglas Fir from the Pacific is not hardy on the Eastern Coast, which differs climatically as widely as it does from the English climate. The German experience as to climatic adaptation should, therefore, be accepted with caution for Eastern United States.—REV.]

Die Douglas Fichte seit ihrer Einführung nach Europa (1828-1906). Allgemeine Forst-u. Jadgzeitung. Jan., Feb., Mch., Apr., 1907, pp. 5-10, 45-50, 87-93, 113-118.

Spruce Production.

An enormous product of Norway Spruce is reported from a Württemberg experimental area, which with now 300 trees to the acre, 79 years old, had by only slight thinnings furnished 5400 cubic feet and had a present volume of 9630 cubic feet, altogether 15,000 cubic feet, which corresponds to an increment in the last 30 years of 330 cubic feet per acre per year.

In the same neighborhood an 83-year-old spruce stand on sand soil of first quality, having been more severely thinned contained 243 trees of excellent development and form, with 60 feet of clean bole and near 40 feet of crown. In 25 years the thinnings had furnished 6810 cubic feet and the present volume was 9200 cubic feet, closely approaching the former stand.

In a 30 year old stand five degrees of thinning on a quarter acre each had been practised for 10 years. The best increment was attained with a light thinning (B degree) which left 1500 trees to the acre, the increment being 177 cubic feet per annum. Severe thinning in the dominant proved itself not adapted to the spruce, for within 10 years out of the 1400 trees left in the sub-dominant 820 died, the spruce not being able to support the shade of the spreading isolated trees of the dominant; of the 800 of these left in the 10 years nearly 10% had succumbed.

The influence of various spacing in plantations in rows, 8 m

apart is exhibited by five trial plantations of one quarter acre each, on glacial drift, at the time 31 years old, as follows:

Area,	I	II	III	IV	V
Spacing, ...m..	1	1.25	1.50	2.00	2.50
Original number,	10576	7676	6940	6044	4712
Present number,	2736	2496	2292	2148	1776
Cross section area of stand,..m².	25.6	27.3	27.9	26.6	27.6
Diameter average tree, ...cm..	10.9	11.8	12.5	12.6	14.1
Average height, ...m..	11.7	12.4	13.3	12.5	13.7
Present volume, ...fm..	241	274	283	259	280
Total increment in 31 yrs.,..fm..	464	437	437	408	434
Crown length of dominant, ..m..	6.0	7.8	7.7	7.6	8.8
Breadth of crown, ...m..	2.8	2.9	2.9	2.0	3.2

These results would all in all give the spacing of 1.5 m, or say $2\frac{1}{2}$x5 feet, the preference.

The diameter in the direction of the rows (difference of spacing) compared with those vertical thereto were in I and II respectively .5 mm and .1 mm smaller in III, IV, V, .5, .7, 2.2 mm larger.

In another set of such trial plantings in 10 various spacings varying in both directions, the spacing of 3x5 feet (1x1.5 m) showed after 30 years the largest product (272 fm) and the largest yield in thinnings (30 fm), while the widest spacing (3x2 m) showed the smallest result (151+8 fm), besides, the trees spaced 2x2 *m* and 3x2 *m* were short, branchy and still with crowns to the base. These trial plantings showed that square spacing gives the best results.

A number of other interesting results in larch, fir and beech stands are recorded in the same report.

Fünfte Versammlung des Internationalen Verbandes forstlicher Versuchsanstalten. Centralblatt f. d. g. Forstwesen, March, 1907, pp. 124-127.

Influence of Wind.

In continuation of the article by Emeis briefed on p. 96, the author discusses the behavior of different species under the influence of strong winds.

Norway Spruce, which had been used for wind mantles, has in the long run not proved efficient, being either broken when 30 to 40 years old or succumbing to drying out due to the continuous motion of its slender stems in wind swept exposure. This latter effect is observed even in 15 to 20 year plantations. Large groups in the deciduous forest are apt

to be broken, only single intermixture in beech forest furnishes satisfaction.

Larch is less liable to breakage, but strong winds lead to a broom-like development, damaging its usefulness.

Fir supports longest and best the untoward conditions of wind and weather. Its thick glossy foliage resists wet and cold and it thrives on poorer soils than it is often given credit (like our Balsam!). Yet under the strong sea-winds it is apt to lose the end buds and make double leaders.

The American White Spruce and the Austrian Pine are the best adapted to such exposed positions, where the soil is adapted quire the wind." In the mixed forest, when crown cover closes up, they succumb in the wet climate under consideration except to them. They require open position, and, the author claims, "re-on the windswept exposures.

Birch (White), when 5 to 6 m. high, mostly dies down to its base, sprouting then uselessly in these open situations exposed to the sea-winds.

The history of these windswept heaths of Schleswig-Holstein in general is the impoverishment of many enterprising agriculturists, yet within short distances climatically favorable conditions permit flourishing farm industries. To protect the fields earth walls are thrown up and planted with the dwarf shrubbery described, "Knickbusch," to break the force of the winds.

Co-operative work to improve conditions is advocated by the writer.

Ungünstige Einflüsse von Wind und Freilage auf die Bodenkultur. Allgemeine, Forst-u. Jagdzeitung, Feb., 1907, pp. 41-45.

Measures of Protection Against Wind Damage.

This theme was discussed at the meeting of the Saxon forestry association. The only possibility is prevention by systematic effort to secure wind-firm stands. In addition, since in the modern forester's forest as many sound, cylindrical clear trees as possible are to be grown, the close stands must be provided on the endangered side with a wind mantle of windfirm trees and an interrupted crown surface. Forest pro-

tection must borrow from all other branches of forestry, notably silviculture and forest regulation.

In Saxony the extensive planting of spruce, historically forced upon the administration, as the speaker pointed out, has accentuated the necessity of looking out especially for wind damage, and the speaker contends that Saxon foresters have done all that human ingenuity could invent. The preventive measures lie in the manner of planting and in the aftercare. Instead of sowing or bunchplanting, the use of first class plants set singly, and draining or proper distribution of water over the ground have been the silvicultural measures. Lately, admixture of broadleaf species, not in single individuals, but in rows along the outer boundaries and through the spruce plantations vertical to the wind direction has been introduced.

In the aftercare appropriate thinnings play the main role, and especially preparatory thinnings which have in view the establishment of windfirm portions in extensive even-aged stands preparatory to possible severance fellings.

In the conduct of the fellings, the cutting of strips in echelons and the unregulated selection felling have been abandoned, and a combination of strip and nurse-tree system starting from the leeward, or else direct clearing have been introduced. By progressive fellings proceeding from the leeward side, a slanting roof of crowns is to be secured.

The establishment and care of wind mantles has been lately specially prescribed by official orders. The main aim is to secure on a strip of 20 to 40 m. a number of well rooted and full crowned trees in single open position, using in planting about 1,600 trees to the acre, but in the course of years thinning them out to 1 in 10. Our White Pine, Scotch Pine, Larch, and broadleaf trees are available for this purpose. The windmantle is not to be a close wall changing the direction of the wind, but a real "wind break."

Measures of forest regulation which have been found desirable are the evening out of boundaries, avoiding projecting angles, the introduction of lower rotations; the progress of fellings from the leeward to the windward and proper locations of age classes for which the clearing system gives the quickest opportunity, which also requires a desirable systematic sub-division.

Severance fellings which originated in Saxony are one of the

best means to counteract wind damage. They are to be made of sufficient width; "the not insignificant sacrifices of productive area have paid for themselves abundantly in Saxony." Formation of small felling series are another means of reducing wind danger.

Bericht über die 50. Versammlung des Sächsischen Forstvereins. Allgemeine Forst-u. Jagdzeitung, Feb., 1907, pp. 65-67.

Prevention of Avalanches.

The methods employed in Switzerland to prevent or reduce the damage from avalanches are described by Prof. Engler in some detail. The first great work on this subject was published by Dr. Coaz in 1881. The practices in Austria were described in a volume by Pollack in 1891. As in the treatment of torrents both mechanical means and reforestation are employed.

The mechanical means consist of horizontal ditches, terracing, setting rows of posts, or, on rock, of T iron connected by wooden braces, snow bridges, walls of stone, or earth walls, sheds, wire netting, etc. All these structures have the object to make the movement of the snow at places in the region of the origin of avalanches impossible, or at least to limit it, to prevent the sliding on the ground and the blowing, the formation of snow shields which in breaking off are apt to occasion snowslides, or else to quiet the moving snow.

The author discusses at length the forces which the works must withstand, quantities and density of snow, friction and cohesion, etc. Details of caluculations are given. The conclusion is reached that a maximum depth of 6 to 10 feet and a weight of 25 lbs. to the cubic foot of snow will be usually sufficient to provide against. A table gives the calculated pressures to be withstood by the works, and careful determination of dimensions for different classes of works are presented, and a few pictures illustrate their disposal.

Rows of well seasoned piles 5 to 6 feet long, split to 5 or 6 inch face, driven into the ground to half their length, $1\frac{1}{2}$ to 2 feet apart, the rows according to the steepness of slope from 8 (at 40°) to 40 (at 30°) feet apart, can be useful only where the soil is deep enough and only in the upper slopes near timberlimit, as a

temporary works before reforesting. Where reforestation is impossible or too difficult or the rate of growth too slow, and in very snowy and steep situations, where the ground is liable to landslides, pilework is not applicable. It must altogether not be overlooked that after the works have been established the soil must take up the water of the melting snow masses which formerly went down as avalanches and this on permeable loam soils is apt to produce landslides. Such places must be drained by open ditches. Pile works especially must be carefully maintained in good order for a long time to be effective, and that is expensive, so that walls and terraces although somewhat higher in first cost are more satisfactory. The piles may be used in less unfavorable situations, smaller locations within the forest area, and in combination with walls and terraces to reduce cost, the character of soil and slope furnishing the basis for choice of works.

A combination of walls and terraces is the most effective preventive of avalanches. The most effective height of a dry wall is 4 to 6 feet and about 3 feet at the top, at the foot at least 4 feet. The base is best cut into the slope and made somewhat slanting towards the mountain side. To prevent somewhat, waters from penetrating the wall and to protect it generally, the top is covered with sod, deeply cut, or after placing first earth on it so that the sod will grow. With stone close at hand and labor at $1 per day the cubic foot of such walls may cost 3.5 to 4 cents. The main points to keep in mind in constructing such walls are that they must not slip on their foundations or turn over their outer edge. A table shows for different grades and with dimensions as above the distances at which walls should be placed, the horizontal distances varying from 20 feet (at 45°) to over 100 feet (at 30°) as outside limits.

Horizontal terraces of 1½ to 3 feet width, with the balk built up on the down slope side give added stability to the snow when placed behind walls and piles. By themselves they will be rarely found efficient.

As regards the ability of forest to prevent avalanches, it must be admitted that in even-aged, open forest snow on steep, slippery ground may get into motion; only in well stocked selection forest is entire security to be attained, when dense young and middle-

aged groups and old timber alternate. Dense, even-aged young growths also furnish protection, but they thin out with age and become less effective. At timberlimit on steep slopes even the uneven-aged forest becomes too open to be effective, and only solid, permanent walls will furnish protection. Since then the effectiveness of reforested areas which are naturally even-aged, diminishes with age, assistance by artificial works, walls and terraces must in such conditions be planned for, and these even when dilapidated in combination with the forest growth remain effective, like anything which increases unevenness of the ground. Leaving of high stumps is, therefore, a proper measure. The forest is effective not only by the mechanical barrier of the stems, but less snow reaches the ground (as much as 40% less in coniferous stands) much being intercepted by crowns, and the blowing being prevented.

In reforesting, all means should be employed which make it easy gradually to change the even-aged into uneven-aged forest. This is done by holding over any existing volunteer growth which does not hinder the plantation, by proper mixture, by avoiding planting in rows and instead planting in groups, 3 to 5 plants to the group, the groups 6 to 12 feet apart, avoiding depressions near the foot of plants, where snow would accumulate and persist, retarding growth, hence also no planting should be done on the balks of terraces. Early beginning of group wise reproduction will secure the desired end.

Ueber Verbau und Aufforstung von Lawinenzügen. Centralblatt f. d. g. Forstwesen, March, April, 1907, pp. 93-102, 141-161.

MENSURATION, FINANCE, MANAGEMENT.

Rapid, Accurate Method of Measuring Stands.

Mr. Schleicher, whose investigations into the value of the space number for measuring the volume of stands were briefed in vol. IV, p. 166, has in a long article elaborated with all detail the proper methods of employing this aid. The method by sample areas, which was known as far back as the seventeenth century, admittedly requires a large amount of judg-

ment in selecting the sample and properly relating it to the unmeasured parts. The value of this method and the limitations of its application are discussed at length on the basis of a series of investigations which, the author concludes, justify Dr. Kuntze's declaration that the "sample area method of determining the volume of stands should finally be entirely discarded."

After pointing out the defects of the hitherto proposed use of the space number, he develops his new method, which involves the measuring of circular sample plots according to Zetzche's proposition merely for the purpose of determining the factors of the space number; namely, the determination of the average diameter of the stand, and the determination of the average standing room.

Before beginning operations the stand to be measured must be superficially studied in its character by a reconnaisance, and on an outline map the direction should be noted with pencil which it is desirable to travel in order to touch more or less uniformly the differences in the stand conditions. Then with a light but stiff lath or bamboo of say 10 feet (3 m.) length, which can be easily held horizontally at arm's length walk through the stand in the noted directions, stop at regular intervals and caliper all the trees which can be reached with stretched arm tangent to the lath in a radius with the breast of the observer as center. The size of the area enclosed varies, of course with the personal equation of the observer and must be calculated for each accordingly. To avoid duplication the lines traversed should be marked by paper tags or otherwise. The results of each small sample plot are kept separate. The distance of sample plots from each other (measured by stepping) should be uniform, longer in regular and large stands (say 75 to 80 paces), shorter in irregular and smaller stands (50 paces), so as to secure a larger or smaller number of samples as desirable. No attempt at selection of plots should be made but the regular interval kept which insures a better averaging than would be secured by selection, hence while walking observe the soil cover rather than the character of the stand; nor should there be an attempt to reach trees, but on the contrary to enclose each time as near as possible the same area. In the plain, a uniform distribution of sample plots is easy; in mountainous country it is best done by starting from the lowest

portions and running lines in more or less parallel directions along and up the slope. In very irregular topography it is advisable to make first subdivisions, and operate each separately. The calipering is, of course, done by diameter classes. Since the sample plot measuring is done to determine standing room and average diameter, the four to eight diameter classes lying near the presumable average diameter (estimated beforehand) should be made closer, say 1 inch or half-inch, while the stouter, slimmer classes may be taken more summarily and do not need to be calipered, but merely counted.

The average diameter is found by dividing the total number of trees in the middle diameter class and the four lower and higher diameter classes into their total cross-section area, and finding the diameter corresponding to the quotient area The middle diameter class is readily found according to Weise's prescription by counting to 40 per cent. in intolerant, 45 per cent. in tolerant species from the stoutest class down. In regular stands the dameter of the 40th or 45th per cent. tree has approximately the arithmetical mean diameter.

The side (s) of the square of average standing room may be read from a table which is constructed upon the consideration that in a regular stand in which trees stand 4×4 m. apart a circular plot, if a 4 m. radius is used, would contain 4 stems; if the trees were 3×3 m. apart, 5.78 stems; if 2×2 m. 12 stems, and so on. From the platted curve of this relationship all intermediate positions can be found. For a 3 m. radius the following table can be deduced.

Average Side of Standing Room when Radius of Sample Plot equals 3 m.

Number of stems on plot	Side of standing room	Number of stems on plot	Side of standing room	Number of stems on plot	Side of standing room
32 —30.5	1	12.4—11.5	1.7	6.4— 6	2.4
30.4—26	1.1	11.4—10.5	1.8	5.9— 5.5	2.5
25.9—22	1.2	10.4— 9.5	1.9	5.4— 5	2.6
21.9—18	1.3	9.4— 8.5	2	4.9— 4.6	2.7
17.9—16	1.4	8.4— 7.5	2.1	4.5— 4.3	2.8
15.9—14	1.5	7.4— 7	2.2	4.2— 4.1	2.9
13.9—12.5	1.6	6.9— 6.5	2.3	4 — 3.9	3

The average number of trees per sample plot is of course found by dividing the number of plots into the total number of trees found.

Now the space number is $a = \frac{s}{d}$, and the cross-section area for 1*ha* may be read from the following table:

SPACE TABLE

Space Number	Basal Area of Trees per 1 ha.	Space Number	Basal Area of Trees per 1 ha.	Space Number	Basal Area of Trees per 1 ha.
	9m		*9m*		*9m*
12	54.54	15	34.90	18	24.24
12.5	50.27	15.5	32.69	18.5	22.95
13	46.47	16	30.68	19	21.76
13.5	43.09	16.5	28.85	19.5	20.66
14	40.07	17	27.18	20	19.64
14.5	37.36	17.5	25.65	20.5	18.69
21	17.81	24	13.64	27	10.77
21.5	16.99	24.5	13.08	27.5	10.38
22	16.22	25	12.56	28	10.02
22.5	15.51	25.5	12.07	28.5	9.67
23	14.85	26	11.62	29	9.34
23.5	14.22	26.5	11.18	29.5	9.03

[To translate qm per ha. into square feet per acre multiply by 4.35]

It is claimed that this method of volume measurement gives results very closely approximating individual calipering, saves labor, one assistant being sufficient, and requires 2½ to 4 times less time.

It is not to be recommended for stands of less than one acre and in very open, or very irregular stands.

Neue Methode zur raschen und genauen Ermittlung des Holzgehaltes ganzer Bestände. Allgemeine Forst-u. Jagdzeitung, March, 1907. pp. 77-89.

Measuring Density.

Dr. Ramann has inventetd an apparatus for measuring light effects, which can be practically applied for determining density of crown cover. The apparatus records light intensities in absolute measure of normal candle power. Sixty measurements can be made in one hour. The apparatus is based on the principle of the metal Selenium becoming an electrical conductor by the influence of light in proportion to the intensity of

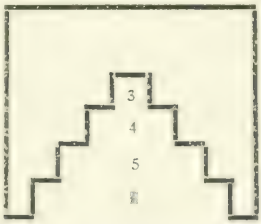
the light. It consists of a selenium cell connected by wire with a explained by the fact that this diameter is not in any relation to exactly measures the intensity.

Fünfte Versammlung des Interationalen Verbandes forstlicher Versuchs anstalten in Württemberg, 1906. Centralblatt f. d. g. Forstwesen. March, 1907, p. 128.

Small Dimension Calipers. Calipers ingeniously constructed on the principle elucidated by Gleinig (see p. 102 of this volume) for measuring small dimensions are manufactured in four sizes and gradations by Wilhelm Göhler's Wittwe at Freiburg, Saxony.

Model A with 2 cm. divisions, fit for measuring mine propes from 6 to 20 cm., costing 9 mks, and Model D with 1 cm. divisions running from 10 to 30 cm., fit for calipering small trees below 12 inches costing 18 mk, seem the most practical. The former is especially useful for woodchoppers to find the diameter at which to cut.

A much simpler caliper, however, is the home-made one of the construction indicated in the schematic figure, which is best cut out from a sufficiently stout sheet of iron, supplied with a wooden handle, or, not so well, out of a board.



Die Forstmeister Gleinigsche Grubenholz Kluppe "Einfach," and *Eine alte einfache Stangenkluppe.* Allgemeine Forst u. Jagdzeitung. March, Apr., 1907, pp. 110, 146.

Economy of Recording Calipers. A series of trial measurements by Dr. Hemman, reported with tabulated detail, brings out the fact that calipering with Wimmenauer's automatic recording calippers—besides being more accurate—*saves half the time and two-thirds the cost of calipering with ordinary calipers.*

The proportion of hourly performance with the two instruments was:

in pure, level spruce stand, 1:1.9;
in mixed spruce, pine and hardwood understand, 1:1.4;
in old open beech stand with dense undergrowth, 1:2.6;
in general, on 62,050 stems, 1:2.

Dispensing with the tally keeper and saving in time reduced the cost in the proportion of 2.7:1.

The excess in purchase price of the registering calipers over the common of 65 Mark (39,144 stems costing with ordinary calipers 126 Mark), is refunded with interest at 3% after 32,078 trees are calipered.

Die finanziellen Vorzüge der selbstregistrirenden Wimmenauer'schen Kreisflächenzählkluppe. Allgemeine Forst u. Jagdzeitung. Mch., 1907, pp. 93-96.

Form Factor of Trees.

In presenting the results of form factor measurements the Forest Service gives this very clear explanation of the form factor: "Any one estimating timber or having any connection with the woods end of lumbering knows that one species of tree will scale and cut more lumber than another of exactly the same diameter and height. This is due to the shape of the tree. The one will be full bodied and keep its diameter well up into the short, bushy top, while the other is more slender with more rapidly tapering logs and long, narrow top. In the East the old White Pine was an example of the full bodied tree, the Hemlock of the tapering tree. In the West Yellow Pine grown in the Black Hills, Arizona, or the lower Rockies is much fuller bodied than the same species on the west slope of the Sierras in California and Oregon. Douglas Fir in the Rockies is fuller bodied than the same species around Puget Sound. The cause of this difference is that the form of the tree is by nature different in different species of the same locality, or environment causes different forms of the same species under widely different conditions and localities. Thus White Pine and Hemlock vary in the East under the same conditions, and Western Yellow Pine of the Black Hills varies radi-

cally from Western Yellow Pine of the upper Sierras in California. The cause of the latter difference is the slower growth and open forest of the Black Hills against the very rapid growth and dense forest of California.

In estimating, a lumberman mentally makes allowance for this difference in form. It can however be expressed accurately by comparing the volume of the tree with the volume of a cylinder of equal diameter and height. Thus if a tree 24 inches in diameter breast-high and 100 feet in height had a volume of 157 cubic feet, and a cylinder of the same dimensions had a volume of 314 cubic feet, the relation would be 157/314, or $\frac{1}{2}$, or decimally .50. This mathematical relation is called a form factor. If the volume of another tree of the same dimensions were 188 cubic feet, its form factor would be 188/314, or .60, which would show a more full bodied tree and would scale 60/50 or 120 per cent. of the first tree's scale, were the same number of logs cut from each.

From a large number of accurately measured trees the Forest Service has established the average form factor for Lodgepole Pine in Montana to be .55 with a range of from .58 for 6-inch trees to .42 for 22-inch trees. Douglas Fir in Idaho and Wyoming varies from .58 for 10-inch trees to .40 for a 40-inch tree, with an average of .49 for merchantable trees. Western Yellow Pine in the Black Hills has an average form factor of .53 which does not vary much. In the Sierras of California it is .42 with a range from .45 to .39 as extreme averages—a very small variation. In other words, Western Yellow Pine in the Black Hills would be expected to give a scale of 55/42 of the scale of a tree of the same dimension in the Sugar Pine—Yellow Pine belt of California. This would be more than $\frac{1}{4}$ more in the former region and is further greatly increased by the closer cutting in the Black Hills where better local markets are found for the lower grades of lumber."

Forest Service Trade Bulletin No. 15. May 17, 1907

Bark Per Cent. in Pine.

From the Austrian Experiment Station Schiffel reports interesting investigations into the thickness and contents of the bark of Scotch Pine, which may correspond to conditions in some of our own pines. The investigations were made on 136 trees. It was found that for volume determination satisfactory results can be secured by measurements on stump, breast-height, $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ of the height, when the volume is found by the formula— $v = .6 \left(\frac{a_0 - a_1}{}\right) + \frac{h}{4}\left(\frac{a_2 + a_1 + a_2 + a_3}{}\right)$

The results show, that the thickness of bark (different from spruce, fir, larch) varies very greatly in different regions of the bole and, expressed in per cent. of the diameter with the bark, is greatest on stump and top diameter, while at $\frac{3}{4}$ height it reaches a minimum. With age, increased diameter and height both bark thickness and volume per cent. sink, with an exception at breast-height, where such a lawful decrease is not observable. This is galvanic dry battery and galvanometer, which latter rapidly and the height, as the other diameters are. Altogether the measurements lead to the conclusion that while age and diameter (density and site quality) may have an influence on thickness of bark, practically it is mainly a function of the height. In a given case the base one-quarter of the bole showed a bark per cent. of 19.2 (at stump 26.1), which in the second quarter had fallen to 10.4% (at 45 feet 6.4%), and at three-quarters had again risen to 14.2% (at 60 feet 18.2%), the average of the whole shaft being 14%. While for the bole with bark the form factor was .451, without bark it was .505; without bark, the pine is equal to the spruce in taper. A practical deduction may be made from these relations: *Measured with the bark, the top logs contain proportionately more wood than the butt logs.*

The difference of bark per cent. in different parts may vary from 7 to 20 per cent.

The volume per cent. in trees of 60 to 125 feet in height, varies between 16 and 12 per cent. Hence in making reductions for bark when measuring standing timber, the height of the stand must be taken into consideration.

Stärke und Inhalt der Weissföhrenrinde. Centralblatt f. d. g. Forstwesen. March, 1907, pp. 102-108.

Principles in Constructing Yield Tables.

At the meeting of the International Association of Experiment Stations, Flury points out the need of better agreement on the principles which should rule in the making of yield tables.

For volume determination, he admits, the different sample tree methods, if samples are successfully chosen, give good results, but not for the determination of increments. Especially the methods of Speidel and Kopezky with volume curves, in which the diameters of the different sample trees appear as abscissae and the volumes taken from volume tables as ordinates are criticized. A better method is to use as abscissae the cross section areas and the volumes corresponding to these, these points forming the basis for the equalizing curve, which, however, is also liable to errors.

As regards calculation of height, the formula $h = \frac{Sa.\,ah}{A}$ undoubtedly gives the correct average height, yet in practical application of the yield table, when it is customary to determine the height of the stand to be compared by arithmetic means, a correction becomes necessary, for the latter is always smaller than the correctly calculated height of the yield table. The yield tables should, therefore, contain both heights.

Regarding age determinations, it has been found that when the age was determined as arithmetic mean of the age of all sample trees a later survey of the stand often shows a higher age than the addition of the actually passed time to the originally determined age would make it.

Lorey has pointed out, that not only an absolute growing older of stands takes place but a relative aging by virtue of the dying out of younger age-classes, so that the remaining trees show a greater average age, hence the above experience. Whether the actual or the "managerial" age should determine has been a matter of controversy, the reporter deciding for the latter, siding with Lorey. Lorey had investigated the height and diameter development in the narrow-ringed center of long suppressed young growth and decided to assume as their correct age the number of years which these trees would have probably needed to make their diameters and heights under ordinary circumstances.

In the Sihlwald the reporter found that suppressed spruce, cut

out in A and B grade thinnings, showed a loss of 8 years in their age as determinable by the whole, while those coming out in the C and D grade showed their proper age. In another investigation on spruce sample trees, he found that almost 80 per cent. of the trees below the arithmetic mean stem had a lower age than the calculated one.

Regarding the determination of site quality by either volumes or heights, the latter because most independent of the treatment of the stands and least changeable is the best index, yet since the volume is the important item it should also be considered, but such volume determinations must not be adopted promiscuously for large territories as site qualifiers.

A great source of error is found in the determination of the form factor through the use of only a few stems instead of whole stands. This is the reason that the laws of the relations of form factors appear often contradictory.

Great discrepancies in yield tables of different authors and with different species arise also in volume and stem numbers due to different site classification and different treatment of stands which have been used for the yield tables, whereby some stands become really unserviceable for comparative study and should be ruled out. The experiment stations must investigate the influence of a certain factor without reference to what the practice may determine in its application.

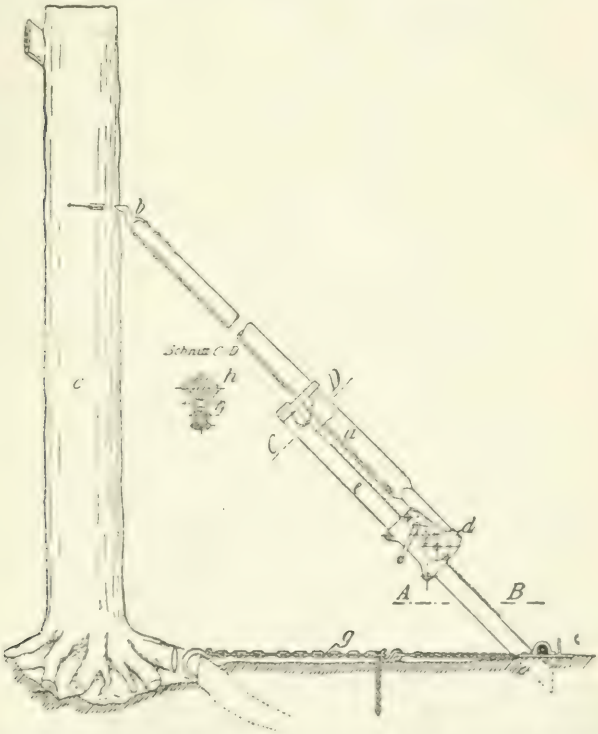
Fünfte Versammlung des Internationalen Verbandes forstlicher Versuchsanstalten. Centralblatt f. d. g. Forstwesen. March, 1907, pp. 117-121.

UTILIZATION, MARKET, TECHNOLOGY.

Felling Apparatus.

Acknowledging the woodchoppers' aversion to any new tools, the foresters' business is innovation all around, new ways of looking at things, new methods, perhaps new tools. An innovation in tools is "Büttner's Baumwinde," which we may call *felling boom*, the invention of a German forester, the accompanying picture describing it and its application. It enables the wood chopper to throw a tree, even a leaning one, in

any desired direction, without cutting a kerf by merely cutting off the stouter roots, and then pulling the balance. Besides throwing the tree with least labor precisely where wanted, it permits to cut the butt as close to the base as possible, which may mean a saving of 8 to 10 per cent. of saw material. It is also a good and simple stump puller and can be used as loading apparatus or general power work. The lower portion, a steel plate rack with pinion and curble, a winch, weighs 325 lbs, the push pole adding 125 lbs. the cost being about $60 in Austria, but can probably be built for less. It can develop a power of from 25000 to 50000 lbs. with two men at the winch. It takes three to four minutes to adjust the device to the tree and two to three minutes to throw it after the roots have been severed, which may require as much as fifteen minutes.



In some trial fellings at Mariabrunn, under favorable conditions (deep and stout root system and tenacious soil, the trees having

very stout branches, hence precision of direction essential), 7 trees of about 70 feet height and 14 inches diameter of various species were quickly and satisfactorily thrown, the device was declared excellent, wherever it is desirable to use it.

A number of testimonials in a circular by the patentee are of the same tenor, among them one referring to the felling of 25 beech trees, with an average diameter of 3 feet, leaning over a neighboring spruce stand; these had been left standing because of the unavoidable damage, if the felling had been attempted by usual means.

It is claimed that a gang of woodchoppers can, in a given time, fell twenty to thirty per cent. more trees with this device than in the ordinary way. The device is patented, and H. J. Bildhauser, No. 44 Broad street, New York City, has control of the patent in the United States.

Büttner's Baumwinde. Centralblatt f. d. g. Forstwesen. Feb., 1907, pp. 62-67.

Notes on Utilization.

A series of very interesting articles upon "The Utilization of Wood Waste by Distillation," written by W. B. Harper, M. S., is appearing in the St. Louis Lumberman. They treat the subject in great detail and are well illustrated.—The St. Louis Lumberman, February 15, 1907, and later.

There is located at Lynchburg, Virginia, a plant with a capacity of thirty to forty cords daily, which is experimenting with a recently discovered process by which paper pulp can be successfully manufactured from the longleaf pine. In experimenting on a method for extracting turpentine from the slabs and edgings by a mechanical or chemical process it was discovered that the wood was available for paper pulp, particularly fit for straw board. It was found that a cord of the yellow pine would produce about a ton of pulp and from 20 to 30 gallons of turpentine. In as much as the present waste in sawing equals almost 50 per cent. of the contents of the log, this process, if it can be developed to a point where the cost will allow a general marketing of

the product, will mean a great saving to the lumberman.—The Southern Lumberman, February 10, 1907.

"The once despised tamarack has come to the front to stay until the supply shall have been exhausted. Substitutes for white pine in box making have carried tamarack into the list. One concern in Michigan manufactured over one million feet of tamarack lumber in 1906."—American Lumberman, February 2, 1907.

Prices of Stumpage in Switzerland.

A continuous rise in stumpage and log prices is noticeable in the sales reports from Switzerland.

The advances for logs are generally more than 1 cent or over 10% per cubic foot over the previous year, and in many instances two to three times that amount, ranging between 14 and 20 cents per cubic foot (or, say $30 p. M. BM.) in the woods, the haul adding usually from 1 to 3 cents.

Holzhandelsbericht Schweizerische Zeitschrift für Forstwesen, from month to month.

Rise in Wages.

The following comparison of wages paid in the hemlock camps of Wisconsin and Michigan in 1896 and 1906 will explain in part the increased cost of lumber. In these prices board is included.

Teamsters,	$16	$31—$45
Swampers,	13	24— 35
Choppers,	14	30— 38
Loaders,	20	35— 48
Graders,	13	28— 35
Chain tenders,	16	28— 35
Blacksmiths,	35	45— 75
Cooks,	40	35— 85

Northwestern Hemlock Manufacturers Convene. American Lumberman, February 9, 1907.

Rules for Timber Tests.

The detailed method for timber testing adopted by the fourth meeting of the International Union for Testing materials, at Brussels, in September, 1906, are essentially as follows, as reported by Schwappach:

I. Origin of Material.

Site and stand from which taken; growth of the tree and form of bole and crown; origin and silvicultural treatment. Age. Season of felling. Kind and amount of drying before testing; position of test piece in the bole.

The height from which test pieces are to be cut depends upon the purpose of the tests. To obtain average figures for the whole tree take beams 7-10 meters from the ground and compression pieces just above or below. For testing poles for use as supports—mine props—take the middle portion. To study the influence of height on strength take specimens every 6 meters. In tests made for whatever purpose the height of the piece from the ground should be noted.

II. Characters Evidently Affecting Strength.

On the longitudinal faces note course of wood fibers (grain) and knots. On cross section note breadth of annual rings and variation; the linear measure of the annual rings in one square centimeter surface; the form of the ring, whether annular or excentric; proportion of spring and summer wood, though this may be drawn from the specific gravity where a large number of pieces are concerned.

III. The Technique of Testing.

A. STRENGTH.

Compressive strength is the most important knowledge to be gained of structural timber; next come bending and shearing strengths, and lastly tensile and splitting strengths. Compressive strengths are the best for determining variations in strength in different parts of the same stem, in wood from different sites and from stands differently thinned, etc. Because the rate of loading is of importance, all loads are to be applied at the rate of 20 *kg* per *sq. cm.* per minute. The moisture per cent. at the time of test is to be determined, and strengths reduced to 15 per cent. moisture for comparison.

1. *The Compression Test.*

A complete compression test determines: (*a*) the fiber stress at the elastic limit; (*b*) the modulus of elasticity; (*c*) the fiber stress at the yield point; (*d*) the compression with increasing

load up to the yield point; (*e*) the quotient $\frac{strength}{specific\ gravity}$ when the moisture per cent. is normal (15%).

The maximum load is to be measured on cubical test pieces, while fiber stress is to be determined on prisms square in section and in length equal to three times the depth of one side. The test shall be made between smooth plates, one of which is moveable, as with a spherical head, and the fiber must be straight and parallel to the load. The sides of the pieces are to be planed; careful sawing of the ends is as good as planing.

For general values test pieces are to be cut quarterly from the stem so that the rings run diagonally; for special detailed studies pieces are to be cut so that the rings run parallel to one side. The proportions of sap and heartwood should be given when they occur; pith should never be present in any test piece.

2. *The Bending Test.*

Bending tests are to be made on rectangular beams, supported on roller bearings at both ends and loaded in the middle. Local comparison is avoided by applying the load through a hardwood block as wide as the beam, one-tenth as long as the span and one-eighth as thick as the beam.

For general values beams are to be cut quarterly, four from a round stick as with compression pieces; for detailed studies the rings should run parallel to the direction in which the load is applied. Actual position in each test is to be indicated in a sketch.

A complete bending test shows: (*a*) The fiber stress at the the maximum load; (*d*) a stress-strain diagram showing deflec- elastic limit; (*b*) the modulus of elasticity; (*c*) fiber stress at tion with increasing load up to rupture; (*e*) the work at the elastic limit and at rupture.

Beam deflections are to be read to 0.01 mm. The elastic limit is to be determined from the stress-strain diagram in the usual way, the fiber stress to be calculated for the maximum load, assuming this rate of deflection to be maintained. The work done is to be reduced to a normal beam, 10 x 10 centimeters in section and 1.5 meters long, for comparison.

3. *The Shearing Test.*

Shearing tests shall be made both along the radius and at right

angles thereto along the rings on rectangular projections, the load of the fibers. The load is to be applied to a surface one centi- being applied parallel to the axis of the stem and to the direction meter high and, when radial, 5 centimeters, when tangential, the height to which the load is applied. Stress at failure only is 3 centimeters wide. The length of the shear shall be four times calculated and any indentation is disregarded.

4. *The Tension Test.*

Tension shall be measured on plates 1 *cm.* thick and at least 2 *cm.* wide and 22 *cm.* long, preferably prepared from split material so that the rings run parallel to the faces or to the edges.

5. *Cleavage Test.*

The form of test introduced by Nördlinger is to be followed with the plane of cleavage both along the rings and along the radius. In case the material is not long enough for these tests, Rudeloff's method may be substituted. Only the maximum strength is observed.

B. MOISTURE.

Moisture is to be calculated in per cent. of the dry weight. When possible, use the whole piece for moisture determinations; in large pieces, discs 2-5 *cm.* thick and including the failure shall be removed directly after the test, using a hand saw. Drying is to be carried on in a well-ventilated oven at temperature a few degrees below the boiling point and until variations of three-tenths per cent. of the dry weight no longer occur. The pieces are to be cooled to the temperature of the room in a dessicator over sulphuric acid before weighing. Fifteen per cent. is to be regarded as the normal moisture per cent. for making tests and results are to be reduced to this for comparison.

C. SPECIFIC GRAVITY.

For determining specific gravity the volume is to be measured on carefully squared and planed pieces or to be found by submersions, using Friedrich's precise xylometer. Small-sized pieces are to be protected against the entrance of water by painting with linseed oil or dipped in a solution of paraffine in benzine. Such treatments introduce no appreciable error. Large pieces absorb so little water during the brief submersion as to render these precautions unnecessary.

D. SHRINKING AND SWELLING.

Variations in volume are to be determined directly by submersion or by linear measurements on squared sticks. The simultaneous change in weight is also to be noted.

E. DURABILITY.

Uniform methods for determining durability can not be formulated due to lack of information. Dr. von Tubenf has undertaken to supply this need.

Prüfung der technischen Eigenschaften des Holzes. . . . Zeitschrift für Forst und Jagdwesen, January, 1907, pp. 56-64.

STATISTICS AND HISTORY.

Statistics of Lumber Cut.

The annual statistics of the lumber production in Maine, Vermont, New York, Pennsylvania, Maryland and West Virginia as compiled from the reports of 807 operators by the American Lumberman indicates a total of 2½ billion feet. Of this, Hemlock comprises 46.4 per cent.; Spruce, 17 per cent.; White Pine, 9 per cent., and mixed hardwoods, 27 per cent. The salient feature of the statement is that the east is not going to be out of the manufacturing business at a very early date.

It is significant to note that the meeting expressed disapproval of the methods advocated and practiced by the United States Forest Service regarding the testing of commercial sizes.

The reports of the cut in Virginia, North and South Carolina give a total lumber production of 1½ billion feet against a cut of one billion in 1905. This shows an increase of 50 per cent. The number of firms reporting, however, was 25 per cent. greater than in the previous year. Of this total cut, one billion or about 65 per cent. was North Carolina Pine, indicating a gain of 42 per cent. over that of 1905; Longleaf Pine, 8 per cent.; White Pine and Cypress, 5 per cent.; Hemlock, 1½ per cent., and hardwoods about 20 per cent. By States, North Carolina leads with

50 per cent. of the total cut, Virginia comes next with 33 per cent., and South Carolina, the least, with 17 per cent.—American Lumberman, March 23, 1907.

Statistics for the northern pine cut for 1906, aggregating 3,293 million feet, naturally show a continued decrease of 10 per cent. over that of 1905. This, however, is less than the decrease of 13 per cent. that occurred the year previous, and of 12 per cent. in 1904. According to districts the cut last year was distributed as follows: West of Chicago District, 2.8 billion feet equals 85 per cent.; Chicago District, 407 million equals 12 per cent.; East of Chicago District, 81 million equals 3 per cent.

The Chicago district comprises all of the territory which ships lumber to Chicago by boat, such as Eastern Wisconsin, Upper Michigan and the west shore of Lower Michigan. Furthermore, the westward trend of operations is shown by the figures indicating a decrease of only 8 per cent. in the district west of Chicago, over twice as much or 17.7 per cent. in the Chicago district, and almost twice as much again or 33 per cent. in the district east of Chicago.

Other figures for the cut by districts and in total are given for each as far back as 1873. They show the rise of the lumbering industry to a maximum pine cut of 8.6 billion in 1890 and again in 1892, followed by a constant decrease to the past year, when the cut was less than that in 1873.

The shingle output shows a total of 1.2 billion. This is a 20 per cent. decrease. Lath on the other hand shows an increase of 13 per cent., the total aggregating 1.2 billion pieces.

While the increase in the pine output amounted to some 371 million feet, this was partially made up by an increased production of hemlock, especially in Wisconsin, of 118 million or 9 per cent. over that of 1905, making the total hemlock cut 1.3 billion feet. This was distributed as follows: Chicago District, 440 million equals 33 per cent.; West of Chicago District, 640 million equals 48 per cent.; Michigan Railroad, 151 million equals 12 per cent.; Saginaw District 88 million equals 7 per cent.—American Lumberman, February 23, 1907.

Statistics issued by the Northwestern Hemlock Manufacturers' Association compiled from reports of 238 concerns in Wisconsin

and Michigan indicates a cut for the year 1906, of 974 million feet of hemlock, 256 million lath, and 212 million shingles. Of this amount Wisconsin is credited with two-thirds and Michigan one-third.—American Lumberman, February 9, 1907.

No changes of importance are shown in the grand totals of northern hardwood production during the year 1906. There was turned out in the neighborhood of 1,044 million feet which is only .4 per cent. increase over the cut of 1905.

In round numbers the cut for the past six years has been as follows: 1906, 1,044 million feet BM.; 1905, 1,040 million feet BM.; 1904, 1,044 million feet BM.; 1903, 800 million feet BM.; 1902, 730 million feet BM.; 1901, 790 million feet BM.; 1900, 940 million feet BM.

It is evident that the hardwood lumbering industry has reached its greatest development in this region and that the future will show little, if any increase.

While the output during the past six years has increased materially, the number of mills has decreased from 771 in 1901 to 512 in 1906, and the average cut per mill has increased from 1.1 million feet in 1901 to 2 million in 1906. This plainly indicates a tendency toward consolidation and centralization of operation, for the number of firms decreased 28 per cent. and the average cut per mill increased 38 per cent.

The distribution of the 1906 hardwood cut was as follows: West of Chicago District, 409 million equals 39 per cent.; Chicago District, 336 million equals 32 per cent.; Michigan Railroad, 200 million equals 19 per cent.; Saginaw District, 99 million equals 10 per cent.—American Lumberman, March 2, 1907.

The Michigan Hardwood Manufacturers' Association has issued a tabulated analysis of the hardwood lumber industry in that State during the year 1906, and the outlook for the year 1907. A comparison of the actual cut of the year 1906 and the estimated cut for the year 1907 shows a decrease in the amount of beech, birch and rock elm; a slight increase in the amount of soft elm; an increase of about 10 per cent. in maple (due to increased production of flooring), and the amount of basswood and ash remaining about the same.

The following figures for the cut of 1906 represent 80 to 85 per cent of the total hardwood cut:

Ash, 8½ million feet; Baswood, 26 million feet; Beech, 43 million feet; Birch, 29 million feet; Rock Elm, 3 million feet; Maple, hard and soft, 241 million feet; all others, 15 million feet. Total, 387 million feet.—Hardwood Record, February 25, 1907.

Reports from 896 operators in yellow pine, cypress and central states hardwoods give the following estimate of the cut of 1906,—

Yellow pine, 5.8 billion feet, estimated total, 7.5 billion; cypress, exclusive of South Carolina, 718 million feet. Of the yellow pine production, Louisiana leads with 26 per cent.; Mississippi, Texas, and Arkansas, each 16 per cent.; Alabama, 13 per cent.; Florida, 8 per cent.; Georgia, 5 per cent.

In Cypress, Louisiana also leads with 82 per cent.; Florida comes next with 8 per cent.; Arkansas, 4 per cent., and Alabama, Georgia, Indiana, Kentucky, Mississippi, Missouri, Tennessee and Texas, 6 per cent.

The hardwood cut in the Central States aggregated 2.1 billion feet. This included the product from Alabama, Arkansas, Florida, Georgia, Indiana, Indian Territory, Kentucky, Louisiana, Mississippi, Missouri, Ohio, Tennessee and Texas. Tennessee leads with 22 per cent.; Arkansas, 17 per cent.; Mississippi, 10 per cent.; Indiana and Ohio, each 9 per cent., and all the others 33 per cent.

The species cut were as follows: Oaks, 38 per cent.; Yellow Poplar, 15 per cent.; Gum and Tupelo, 14 per cent.; Elm, 3.3 per cent.; Ash, 2.8 per cent.; Hickory, 2.8 per cent.; Walnut, 1.5 per cent.; all others, 22.6 per cent.—American Lumberman, March 9, 1907.

Reports from the coast indicate record breaking shipments of Redwood during February, when the total movement aggregated over 39 million feet, an increase of 50 per cent. over that of February, 1906. A similar large gain was shown in the reports for the month of January, so that the total shipments for the first two months of this year amounted to almost 73 million board feet as against 49 million the year previous. Practically all this gain was

in shipments to San Francisco.—American Lumberman, March 23, 1907.

The report comes from the State of Washington that during the fiscal year of 1906, there was produced a total of 10½ billion shingles, which equaled 68½ per cent. of the total output of shingles in the United States. This was the production of 459 mills representing a daily capacity of 48 million, an increase of 12 per cent. over that of 1905.—The New York Lumber Trade Journal, February 15, 1907.

An estimate of the winter's log cut in the Province of Ontario, compiled by the Ontario forestry officials, shows one billion feet of pine, 70 million feet of hemlock, 1.5 million spruce, 1.2 million cubic feet of square timber, 100,000 cords pulp, and 4½ million ties.—American Lumberman, February 23, 1907.

Imports for 1905.

Detailed reports of the amount of imports of various woods into this country show that it is no small item and, moreover, is on the increase. During the fiscal year ending June, 1906, the total quantity of mahogany imported equaled 36.6 million feet with a value of $2,500,000. This was an increase over the previous year of 15 per cent. in quantity and 25 per cent. in value. All other cabinet woods showed an increase from $1,077,000 in 1905 to $1,244,000 in 1906.

The importation of logs and round timbers amounted to 100 million feet; hewn and square timber, 256,000 cubic feet; lumber, 950 million feet; shingles, 900 million, and wood pulp, 157,224 tons. The total value of all of these items exceeded $21,000,000, and all except the wood pulp showed an increase in quantity.—American Lumberman, March 9, 1907.

Exports in 1906.

Almost without exception statistics of the export trade during 1906 in "lumber and manufactures thereof" show an increase over 1905. The total value represented in 1906 was over $77,000,000 as against $60,000,00 in 1905 or an increase of 28 per cent. Of the several

kinds, that of sawed timber aggregated 597 million as compared with 494 million in 1905, an increase of 21 per cent.; hewn timber remains practically the same with 3.45 million cubic feet in 1906. The value of all timber and logs exeeded $17,000,000 as against $11,000,000, which was the very large increase of 55 per cent.

It is perhaps still more interesting to compare this with the value of the imports which for all those classified as "wood and manufactures thereof" amounted to over $40,000,000 and represented an increase of 25 per cent. over that of 1905. The excess of exports over imports was valued at $36,000,000 or 90 per cent. more export than import. In 1904 the exports exceeded the imports by 116 per cent. Thus it is apparent that the tendency is towards an equalization of export and import of wood material.—American Lumberman, February 23, 1907.

Export of Yellow Pine.

No absolute figures as to yellow pine exports are available, since the custom house reports specify merely sawed lumber, timber, staves, etc., without naming the kinds. The following figures are the total export of all timber from the Southern States, and therefore include some cypress and considerable hardwood export, particularly from New Orleans and Mobile, but by omitting all Virginia and Maryland, which are large exporters of yellow pine, it may be assumed that these figures approximately represent the exports of yellow pine sawed lumber and timber.

1896,	378	million feet BM.
1897,	470	"
1898,	427	"
1899,	550	"
1900,	629	"
1901,	689	"
1902,	574	"
1903,	592	"
1904,	839	"
1905,	806	"
Total for ten years,	5,954	million feet BM.

A close examination of these exports for 1905 shows that the various States in the order of their importance was as follows: Florida, 33 per cent.; Mississippi, 21 per cent.; Alabama, 15 per cent.; Texas, 13 per cent.; Louisiana, 9 per cent.; Georgia, 6 per cent.; North and South Carolina, 3 per cent.—American Lumberman, February 9, 1907.

Statistics of Forest Management in Baden.

In connection with the Agricultural Exhibition at Karlsruhe in 1906, full information regarding the notable forest administration of Baden was furnished in statistical tables. This country, famous among Americans on account of the Black Forest (a mountain range, not a forest!), vies with Saxony for first rank in excellence of its forestry system.

Of the round 1,350,000 acres of forest only 17.6 per cent. are state forest, but the corporation and municipal forests which occupy nearly 50 per cent. of the forest area also not only under direct control but for the most part under direct management of the state forest administration (for which the government charges a small fee), hence 67 per cent. of the forests is surely well managed, and 33 per cent. of the forests is surely well controlled in its management in so far as for "clearing or, in its consequences, similar cutting" a permit must be secured from the state forest administration. How this restriction has worked may be seen from the statement that in 20 years from 1882, 3,467 permits were asked for, 3,417 were issued, and round 5,000 acres were cleared. Due to the rise of prices improvement in the management of private forests is noticeable, for while in 1882 nearly 30 per cent. of the private forests were reported as destructively lumbered, in 1902 this per cent. appears reduced to 12. During the 25 years, 1880-1904, private owners have reforested nearly 12,000 acres and the state and corporations about 14,000 acres, while clearings reduced the forest area by only 7,500 acres, a gain of over 18,000 acres. To foster this reboisement work the state sells plant material cheaply, pays small premiums and subventions; in the years 1900 to 1904 $6,000 were thus paid in effecting the reforesting of about 1,500 acres, this area needing the protective cover. The distribution among species and classes of

management shows that over 50 per cent. is coniferous forest, and even private and corporation forest shows over 45 per cent. of this type. Only 16 per cent. is coppice and coppice with standards, 8.5 per cent. in transition from the latter to timber forest. Of the 84 per cent. of timber forest, not 8 per cent. are in selection forest, and over 26 per cent. are under a clearing system, 58 per cent. under nurse-tree or group system.

The results are admirable, for the total gross income of all the forests with a cut of 76 cubic feet per acre is $7,000,000, and, since the cost of administration requires only 30 per cent. of the gross income, a net result of round 5 million dollars is obtained, which figuring at 3 per cent. makes the value of this property 165 million dollars.

Prices have risen from 1850, when the cubic foot of all kinds and sizes brought 4 cents, to 7½ cents in 1900. In the state forests specifically, every financial item has more than trebled in that period, namely, the gross income from 1 to 3.5, the expenditures from 1 to 3.4, the net income from 1 to 3.66.

The state forests are, of course, the best managed, and show the largest cut, namely, 81 cubic feet per acre or $6.07, while the corporation forests have a budget of 72 cubic feet, due to a large percentage of deciduous wood, servitudes, forests in transition to timber forest, and more conservative calculations.

Allgemeine Forst u. Jagdzeitung, April, 1907, pp. 135-141.

Activities in Switzerland.

The cut for 1906 in Switzerland was for State forest (93,000 acres) 179,872 m³, for corporation forests (1,300,000 acres) 1,735,909 m³, altogether 1,915,781 m³, or 67.6 million cubic feet. From the 800 acres of nurseries of the federal government .5 million plants, mostly conifers, were furnished for planting, and some 20,000 pounds of seed were sown in forest and nurseries. Over $100,000 were spent on reboisement work, the federal government contributing about three-fifths of that sum. Plans for over $300,000 of such work were approved, with a two-thirds grant of the government. Over 170 persons participated in the eight short lecture courses

of two to eight weeks duration, given in various parts of the federation to underforesters and others.

Aus dem Jahresbericht des eidg. Departments des Innern, Forstwesen, 1906. Schweizerische Zeitschrift für Forstwesen, April, 1907, pp. 136-138.

Cantonal Forest Management.

The decennial revision of the working plans of the Bernese cantonal forest department exhibits the change of conditions in a well-managed forest area of now round 35,000 acres, mostly timber forest, during the last 40 years. The area during this period has been increased by purchases, by nearly 30 per cent. and its tax value is now placed at $3,000,000. The wood sales, which in the first decade averaged $130,000 per annum, now amounts to $210,000 ($6 per acre). This increase in excess of the proportionate increase in area is accounted for by changes in four directions, namely an increased main felling budget from 1,500,000 to 1,670,000 cubic feet; an increase to almost double the amounts for thinnings, or altogether a rise in cut from 1,750,000 to 2,120,000 cubic feet (60 cu. ft. per acre); an increase of the workwood per cent. from 30 to 38 (maximum 42) per cent.; and the rise of the average price for wood from 7 cents to 9 cents per cubic foot (in 1905 to 12 cents; see log prices above!).

Regarding the rotations the report says that they are to be gradually increased in some of the holdings, because "the less private forests are managed for saw timber production, the more obligation in the public forests to produce these sizes." "This is by no means a sacrifice on the part of the State, on the contrary it insures larger yield of material and money; only it requires a larger wood capital in older age classes than firewood production." "This measure has, however, not had a depressing effect on the sustained yield, for the stock corresponding to the higher rotations was mostly already in existence, so that we are in the fortunate position of simultaneously being able to raise the rotation and the felling budget."

For road building during the next decade $10,000 are allowed.

Der neue Wirtschafts plan über die bernischen Staatswaldungen. Scheizerische Forstzeitung, March, 1907, p. 100-104.

Oregon Forests.

Recent compilations credit Oregon with 300 billion feet of standing timber with a present value when manufactured of 4½ billion dollars. It is claimed that the State contains one-sixth of the total amount of standing timber in the country. The estimated cut in 1906 was 2 billion, in 1905 1.3 billion; and in 1904, 1 billion.—American Lumberman, March 23, 1907.

Forest Resources of Kentucky.

In a paper read before the State Farmers' Institute of Kentucky, Mr. H. M. Hale, of the Forest Service, gave some interesting estimates of the forest resources of that State. The total stand of timber was estimated at nine billion feet, of which White Oak leads with 28 per cent., Red and Black Oak represent 21 per cent., Yellow Poplar 19 per cent., Chestnut Oak and Chestnut, each 13 per cent., and White Pine and Hemlock together 6 per cent.

The annual value of the forest products was roughly put at $14,000,000. Of this 5 per cent. represented lumber, 25 per cent. tight cooperage, 7 per cent. ties, and 3 per cent tanbark, veneer and mine props.—The Southern Lumberman, March 10, 1907.

MISCELLANEOUS.

Rights of Officials.

An interesting case of political rather than forestal import is under discussion and legal adjudication in Prussia referring to the involuntary retirement and pensioning of the well-known, late director of the forest academy of Münden, Dr. Borggreve. He was pensioned before the legal age of retirement undoubtedly because of his outspoken criticisms of government policies had made him offensive, and he is contesting the right of the government to remove him prematurely, since this injures his financial condition, and because the enforced premature pensioning can legally be effected only if the immediate chief of the officer declares that "the officer

on account of bodily or mental infirmity is permanently incapable of attending to his work;" which declaration had not been made, and everybody who knows the vigorous claimant knows it could not be made.

The legality of taking recourse to judicial procedure was sustained in the first court. But in the second instance the judgment was against the claimant, and the case has been appealed. The remarkable democratic provision of the law will probably be tested to the very last resort, the Landtag.

Forestry Education.

The question of the methods of education for foresters have lately been strenuously discussed in the European journals. Especially the conditions at the Prussian forest academies have been severely criticised, and their transfer to the University or else their greatly improved and extended curriculum demanded. Weise, the director of Münden, lately resigned, has issued a forceful pamphlet on the subject.

We note with satisfaction that a reform in Baden has copied almost precisely the plan, which was originally adopted in the New York State College of Forestry at Cornell University, namely a four years' course, in which the fundamental branches are completed during the first two years, the forestry branches in the last two years, and two six weeks' practicums in the woods, only that the first practicum there antecedes the entire course, instead of both following the forestry studies.

Die Ausbildung für den höheren Forstverwaltungsdienst. Allgemeine Forst u. Jagdzeitung, Feb., 1907, pp. 63-65.

NEWS AND NOTES.

E. A. Sterling, *In Charge.*

In April of this year the University of Toronto established the first forestry school in Canada as a separate Faculty (one of five faculties composing the University), with Dr. B. E. Fernow as Dean.

The course will be an undergraduate one, with a curriculum similar to the one originally adopted at the New York State College of Forestry, but the entrance requirements have been raised above those accepted by the other Faculties of the University. The four-year course leads to the degree of Bachelor of the Science of Forestry, and after three years' practical employment and presentation of a thesis the degree of Forest Engineer (F. E.) is conferred. A three years' course leading to a diploma as Forester will also be instituted. The sessions begin on October 1. It is expected that the government will set aside a large reservation for practice and demonstration ground, where the juniors and seniors will spend a six to eight weeks' term at the end of the academic work, besides visiting lumber camps during the Christmas vacations. Since the University is financially able to satisfy the needs of a first-class school, and the forestry interests of the Province of Ontario, which has not less than 45,000 square miles of timber lands in its possession, are considerable, the future of this new institution would seem assured.

The Ontario Agricultural College at Guelph, which a year ago instituted a course in farm forestry and established nurseries for the purpose of distributing plant material to farmers, is affiliated with the University of Toronto, and this affiliation will be made closer by having Mr. E. J. Zavitz, in charge of the course and the nurseries, act as instructor in the University also. Mr. A. H. D. Ross, M. A., M. F. (Yale), is expected to be a member of the Faculty.

A rather striking evidence of the broadening field of forestry practice in this country and abroad is shown in the plans of the men graduating from the Yale Forest School this year. For-

merly most of the graduates took up government work, and either remained permanently with the United States Forest Service or went from this Field of training into private work after a few years. This year, out of the 29 men in the graduating class, only 15 have taken the civil service examination. It is interesting to note the plans of the remaining 14 graduates.

Those to enter foreign service are: Mr. C. C. Robertson, who will enter the Department of Forestry in the Orange River Colony after visiting the forests of England, France and Germany; and Messrs. G. C. Piche and Avila Bedard, who expect to take up work with the province of Quebec, the latter after further study in Europe.

Mr. E. S. Woodruff has accepted a position with the New York State Forest, Fish and Game Commission.

The men who plan to engage in private work are:

Messrs. Stephen M. Crowell and Clyde S. Martin, who are to work for the Weyerhaeuser syndicate on the Pacific Coast; Messrs. Jack Bentley and C. P. Miller, who are to be employed by the Ritter Company in West Virginia; William Menter, who has a position with Mr. Millard; W. C. Shepard, with the Pennsylvania Railroad, and Messrs. B. T. Harvey and Raymond Davis, who go with pulp concerns in Maine.

The only graduate to go into entirely independent work is Mr. Hoyt Weber, who will open an office as Consulting Forester in Connecticut.

A new scheme of organization in the U. S. Forest Service went into effect on April 17, as Service Order No. 132. It is an attempt to perfect an organization for handling with greater economy the rapidly growing volume of business attendant upon the intensive administration of the National Forests. This is presented in the form of a somewhat elaborate chart which shows the relations of the various branches, offices and sections to each other and to the head office of the Forester and Associate Forester. One of the aims was to reduce the number of independent offices reporting to the Forester, and as a paper organization this seems to have been accomplished since the main units of administration, called branches, are reduced to four: Grazing, Operation, Silviculture and Products. Each of the above "branches" is sub-divided into two, five, three and three offices respectively, each

office having its own chief, who is responsible to the head of his respective "branch." The offices in turn are sub-divided into sections, each nominally under a chief. In effect, it reduces several offices which formerly reported direct to the Forester, to a place under a branch, and elevates several sections to the rank of semi-independent offices. In the office of the Forester are grouped Law, Information, Dendrology and Inspection, the first and third of which were formerly offices. It is, of course, difficult in a scheme of this kind to secure a natural grouping, which probably accounts for the curious grouping of "Publication" under "Products," "Computing" and "Drafting" under "Wood Utilization," etc.

As part of its forest policy the Pennsylvania Railroad established several large plantations this spring on vacant lands adjacent to the right of way. These lands in most cases were acquired in connection with the straightening and widening of the main line, and in order to escape excessive cost of right of way and damages by reason of stream changes in drainage, or to avoid expensive overhead or undergrade crossing entire farms were often purchased. The utilization of these lands is obviously an economic proposition, and in many cases forest planting promises the highest returns, in addition to a step towards providing for a future supply of cross-ties and construction woods. It also offers an object lesson to land owners adjacent to the railroad lines. The planting this year was confined to lands near Altoona and Mt. Union in west central Pennsylvania, where 280,000 red oak, 180,000 black locust, 7,000 European larch, 5,000 tamarack, 6,000 Scotch pine, 2,500 chestnut, 10,000 pin oak and 1,000 hardy catalpa were planted—a total of about 791,000 trees. In addition nearly 75,000 seedlings were set in transplant rows and 135 pounds of seed planted in the nursery at Hollidaysburg, Pa. The species planted in the nursery, in addition to the above, includes such trees as Norway Spruce, Arborvitae, and Norway Maple, which will be used for screens or snow fences, or for ornamental planting.

The spring field work of the Senior Class of the Yale Forest School is being conducted this year at Grandin, and in Shannon County, Missouri, on the lands of the Missouri Lumber and Min-

ing Company. The students, 27 in number, left New Haven, March 3, and reached Grandin March 7. The work will occupy a period of three months.

Although the entire endowment fund of $150,000 promised by the National Lumber Manufacturers Association to the Yale Forest School for the purpose of founding a Chair of Applied Forestry and Practical Lumbering has not been raised, a large portion of the fund is now available for use, and its accessibility has made possible the reorganization and extension of the present course in lumbering.

Through the kindness of Mr. J. B. White, general manager of the Missouri Lumber and Mining Company, the entire plant at Grandin has been thrown open to the students, who have an excellent opportunity to study logging, transportation, milling and manufacturing methods.

In order that suitable practice in surveying and estimating might be obtained the lumber company constructed two camps in Shannon County for the use of the students. These camps are frame structures, each 16 by 32 feet in size, and are located in the center of the company's holdings, 26 miles from Winona, Missouri. This camp is in charge of Mr. H. H. Chapman, Instructor in Forestry, who trains the men in surveying, estimating, and laying out and determining the costs of logging jobs. He is assisted in this work by Mr. J. C. O'Dell, a timber cruiser and surveyor of thirty years' experience.

The students have made a topographic map of an area 90 square miles in extent, comprising a portion of the holdings of the company. This map was prepared under the direction of Henry Gannett, Geographer of the United States Geological Survey, who spent four weeks in camp supervising the field work and the assembling of the data into a map. The main lines of the survey were run with transits and the secondary part was made by running traverses up the largest ravines or on the most prominent ridges and sketching in the topography on a traverse board. The elevations were determined from barometer readings, checked by a line of levels run through the tract.

The map shows all artificial features, such as roads, trails and buildings, and also the direction and elevation of all ridges. Elevations are shown by 20-foot contour intervals. A party of three

men ran an average of four to five miles of secondary traverse per day, without appreciable error of location or distance. The map will be of assistance to the lumber company which has already begun active logging operations in the region.

Since the completion of this map the students have been relocating the original survey of 1821, blazing the original lines and marking corners, and have begun to estimate the pine timber on the tract.

The field work in camp occupies eight weeks' time and the remaining four weeks are spent in Grandin studying milling, manufacturing methods and grading, and in Reynolds and Center counties studying the logging methods employed by the company. This work is under the direction of R. C. Bryant, Instructor in Forestry.

The company operates about 40 miles of main line and many miles of spurs and has a very competent equipment of rolling stock and motive power. Two mills are in operation in Grandin, one of which has a maximum capacity of 150,000 feet B. M., cuts pine, and the other which has a capacity of 10,000 to 12,000 feet B. M., cuts oak of several species.

A shingle and lath mill, dry kilns, extension yards, a large planing mill, small but well-equipped shops, a general company store, and a hospital constitute the main departments aside from the mills.

The students have an unexcelled opportunity to study, in detail, the general scheme of the plant and the methods of conducting a large lumber business.

The grading of yellow pine lumber is given especial attention for the successful forester must understand thoroughly this phase of the work before he can direct intelligently any forest operation of which logging forms a direct part.

Mr. George K. Smith, secretary of the Yellow Pine Manufacturings Association, visited the camp and gave several talks on grading lumber, lumber prices, lumber associations, their objects and methods, etc.

The term closes June 10th, at which time the students scatter to all parts of the United States, some to join the United States Forest Service, others to engage in private forest work, or to enter the employ of lumber companies.

The German Foresters Association has at present 1,897 members, which gives an idea of the number of practising foresters and forest owners of higher grade in the Empire.

On March 1 of this year, at the age of 85, died the veteran teacher of forestry, Prof. Dr. Karl Gayer, one of the leading lights of modern German forestry, before his retirement professor at the University of Munich. He is especially known by his classical volume on silviculture, in which he preached return from the rapidly growing practice of clear-cutting to natural regeneration and mixed forest, and altogether a closer adherence to the methods of nature and the basing of silviculture on biological study. This volume, published 27 years ago, now in its fourth edition, has been translated into French, and is unquestionably the best book on silviculture.

Gayer's "Forest Utilization" (Forstbenutzung) is another classic handbook on the subject.

The Pennsylvania Railroad engineers who investigated the recent wreck which occurred on a mile stretch of track equipped with steel cross-ties, reported that "if the accident had occurred on the section of track laid with wooden cross-ties it is our judgment that less injury would have been done to the track structure" and they recommend that, "on account of the fact that the damage subsequent to the derailment was more serious than would have been the case with wooden ties, that the remaining steel ties should be removed."

Beginning with its issue of February 1st, The St. Louis Lumberman commenced the publication of a series of papers translated from the German, entitled "Concerning American Forestry," by Professor Jentsch and Dr. Riebel, who visited this country during the World's Fair at St. Louis, for the purpose of making a report on the lumbering conditions of the United States. While many of the facts presented in these articles will be familiar to most persons in this country who are interested in forestry and lumbering, it is of considerable interest to learn what impression conditions and methods in the United States made upon the distinguished foreigners.

In the readjustment of boundaries of national forests some four million acres of land suitable for settlement have been released this year, which thereby become open to entry.

Homesteading of agricultural lands within the reservations is also permitted under Act of June 11, 1906, which is largely taken advantage of, especially by stockmen. The Forest Service seems to welcome these settlements on the limited agricultural areas.

M. Smith, Jr., Cornell, '04, who has been in the employ of the Federal Forest Service during the past three years, has resigned to accept an appointment as an Assistant State Forester of California. Mr. Smith assumed his new duties on May 1st, filling the vacancy made by the resignation of Raymond Tyler, who returned to the Federal service after a year with the State.

State forest work in California is showing increased activity with the opening of the dry season. The State Forester is busily engaged in procuring the financial co-operation of County Boards of Supervisors in an attempt to prevent and extinguish forest fires. Last year eleven counties, mainly in the southern part of the State, appropriated sums for this purpose ranging from $250 to $1,500 per county. Although the fire season is only just opening, two new counties in the northern part of the State, which has always been considered indifferent to forestry, have been added to the list. These are Lake and Mendicino, which have appropriated $500 each. It is hoped that before the close of the present dry season many more counties in the northern part of the State will be won over.

Associations of stockmen and irrigators, which have always been interested in preventing forest fires, are manifesting unusual interest this spring. The State Forester is co-operating with many powerful organizations of this kind, all of which are paying the salaries and expenses of the patrolmen appointed fire wardens. Several lumber companies also are showing gratifying interest.

The planting season in California has ended. During the past winter the State Forester has co-operated with the Union Lumber Company, Fort Bragg, one of the largest owners of redwood timber on the Coast, in preparing a plan for the planting of eucalyptus among redwood sprouts on land cut over by this com-

pany. The redwood sprouts are of varying ages, but in most cases stand too far apart to produce merchantable trees. The object of interplanting with Eucalyptus is to force these sprouts into rapid height growth by the lateral shading of the more rapid-growing eucalypts.

Co-operation with the Central Counties Land Company, which owns over 35,000 acres of land on Clear Lake in Lake county, has resulted in the construction of a 40′x128′ lath-house, for the propagation of Eucalyptus and ornamental species which will be used for commercial and ornamental planting on the holdings of this company. The land of the company extends in a narrow strip around the borders of the lake, with a frontage of 74 miles, and includes also blocks of varying area located in the valleys four or five miles back from the lake shore. The object of planting is to ornament the holdings near the lake, which will be sold for residence purposes, and to establish commercial plantations on the holdings remote from the lake, where colonies of settlers will be placed. Actual planting will be commenced next winter with the seedlings grown in the lath-house now under construction at Lakeport. Assistant State Forester C. H. Sellers is in charge of the construction of the lath-house and the establishment of the nursery.

Two important bills relative to State forestry were introduced in the last Legislature. One provided for the assemblying of all provisions relating to punishment for setting forest fires, for the more certain conviction of those arrested, and for the more equal distribution of the fines collected. This bill became a law. Under its provisions the dry season which was formerly defined as "the period between May 15 and the first soaking rains of autumn or winter" was changed to read "a dry season." In the past some trouble has been experienced through defending attorneys seeking to prove that "a dry season" did not actually exist at the time when fires were started, because in some cases a little sprinkle had occurred between that time and the previous May 15. The fines, which formerly varied from $50 to $1,000, were changed to $25 as a minimum and $500 as a maximum. This change will result in the conviction of a larger percentage of those who violate the

forest laws, in as much as it will eliminate the objection of many magistrates to imposing a fine greater than the value of the property destroyed. It will also place the jurisdiction of cases before the justices, while formerly the maximum fine being over $500 placed the jurisdiction in the Superior Courts and made long, expensive trials, which were objected to by the counties, which formerly received no portion of the fines. The disposal of fines also has been changed. Previously the State received the entire sum, but under the new law the county in which a conviction is procured divides the net fine equally with the State.

The other bill related to the administration and personnel of the State Forestry Department. This bill passed the Assembly without opposition, but was amended in the Senate in such form that it threw a greater burden on the State than on the several counties. On this account it was vetoed by the Governor. The opposition to this bill in the Senate was led by Senator Weed, a former lumberman and at present Chairman of the Board of Supervisors of Siskiyou county, who objected principally to the section giving power to the State Forester to compel lumber companies to clear up dangerous slashings, and to compel county officials to clear the brush from their rights-of-way. The defeat of this bill forced the Department to forego some improvements that were contemplated, but as the old law containing the provisions objected to still stands, the power to compel lumber companies to take care of their cut-over land and counties to clear their rights-of-way is retained.

The Fifteenth National Irrigation Congress is scheduled to meet this year in California, at Sacramento, during the first part of September, and will be accompanied by an Interstate Exposition of irrigated-land products and forest products. The intimate relationship between water supply and forest cover has given an impetus to forestry development in the West which no consideration of the question of husbanding forest supplies could have secured, and it is only fit that the forestry interests should be fully represented at the meeting.

Another propagandist forestry journal has been launched in the mafiazine of the Georgia Forestry Association, *Southern Wood-*

lands, the first number appearing in April under the editorship of Prof. Alfred Akerman, Professor of Forestry at the University of Georgia. The educational value of such local publications cannot be over estimated.

With the month of May the Forest Service has begun to add to the monthly Field Program a very useful section of Notes, containing brief references to new developments in the different branches of the service.

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THE FORMATION OF THE ANNUAL RING OF WOOD IN THE EUROPEAN LARCH AND THE WHITE PINE.

Our forest trees increase their trunks by an annual layer or ring of wood of varying thickness, according to conditions of soil and exposure. This has been so long known and has such slight exception that it is universally accepted, and forms the basis of all our calculations. The phenomena and conditions of the formation of this layer are known in but small part and are largely inferences from our general knowledge of plant physiology and the laws of growth.

Especially the time during which the annual ring is formed, how its formation progresses, and when it is finished, has been rarely made a subject of definite investigation. According to Robert Hartig's and other investigators' findings the duration of cambial activity varies, as well as its beginning, with climate and species disposition. It lasts longer than leaf activity in oak and beech, shorter in other species. The bast formation continues much longer, mostly until cold or dry weather sets in, and mostly ceases during the latter part of August. In single trees (open stand) the upper portions cease first; in dense growth, the lower (temperature?). In poorly fed individuals, the base stops early, even to the absence of the ring. The total time of cambial activity differs with the species. With beech it begins late and lasts two and one-half months, with oak four months, with Scotch Pine and Norway Spruce three months (May, June and July; lower parts: June, July, August). Time of forming different parts of the ring varies and seems uncertain, probably dependent upon weather conditions. Beech (50 to 150 years) had formed one-third by middle of June, one-half by beginning of July, three-fourths by end of July, the whole by middle August. Oak begin-

ning the end of April had formed one-half by middle June, the whole by middle August (but not in branches).

The writer, some years ago, made a series of observations through four seasons on two trees, one a European Larch (*Larix Europaea*), the other a native White Pine (*Pinus Strobus*), which are worth while recording, especially for the striking divergence of the results in the White Pine, which goes far to explain the remarkable productive capacity of that species.

Presumably, there are considerable differences between all species of trees with respect to the progress of wood formation. These particular ones were chosen chiefly because of convenience, satisfactory specimens being near at hand, so that the necessary frequent measurements could be readily taken. It may be noted, however, that the European Larch and the White Pine are probably the best representatives of opposite poles of the evergreen class—opposite, at least, in their practical forest relations.

It was hoped also, that some relation might be established between the rate and time of growth on the one hand and meteorological conditions on the other, although the length of time during which the observations were conducted is confessedly very short. Likewise the constancy of habit of a species from year to year, and also in general, the comparative value of these two species for wood or timber production might be more clearly and positively brought out by these observations. But for each and all points the figures and results obtained should be made to speak for themselves.

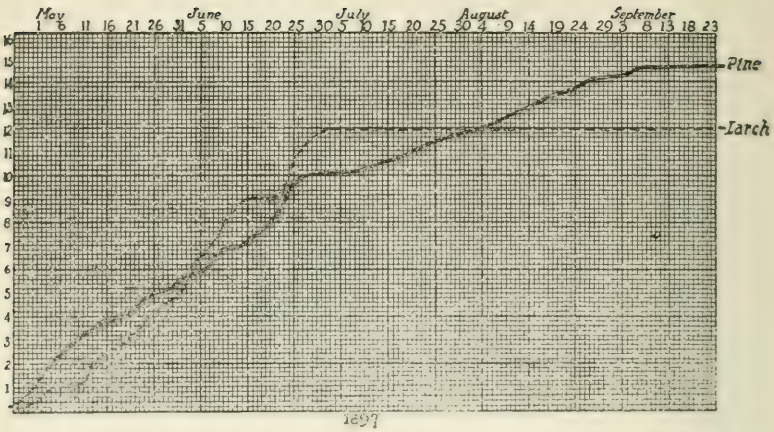
The European Larch used is one of a group of six set as very small trees for landscape purposes, but rather closer than ordinarily, the particular tree in question being six feet and ten feet, respectively, from its nearest neighbors. Trees of other kinds surround this group at moderate distances, so that the conditions are more those of a rather thin and open forest than a park. The trees were about forty-five years old. The records are such that the variations can be but a year or two either way. The individual selected for measurement is now (1907) about 47½ inches in circumference, breast high, and 68 feet in height. It seems to be making a height growth of a few inches per year.

One of the group is larger, girthing 55 inches, and two are smaller. Two trees were removed a few years ago.

The White Pine stands but a stone's throw away under nearly similar conditions. It is further away from its fellows, however, and has less of clear trunk and a better chance to develop side branches. One or two series of lower branches have been pruned off within the last few years. It is approximately the same age as the Larch, and is 55 feet high. It has a circumference of 50 inches; the level chosen, however, was inadvertently made about 12 inches higher than in the Larch. The measurements were taken by a steel tape at intervals of a few days, varying as seemed necessitated by the changes in growth rate. Several small nails were driven slightly through the bark at a uniform level, so that the tape line should be accurately and uniformly applied to the circumference, and care was used to keep the bark surface as even as possible throughout the season, and to avoid taking note of any false enlargement through swelling of the outer bark during wet weather. It is believed that no great error has entered, although it seems probable that, during the latter part of the season particularly, it is not possible properly to take into account the effect of the breaking away of the bark, its swelling in wet weather or its drying and curling at points along the line of measurement.

The observations were made during the four years 1897, 1898, 1899 and 1900.

It will be seen that in each case the growth of the layer of wood began during the last week in April. The exact day seems impossible to determine, at least by this method. Moreover, seasonal differences of temperature and moisture, which doubtless there were, seem to have had no appreciable effect upon the time of beginning of the layer. The beginning of wood formation is likewise practically coincident with the appearance of the new leaves of the Larch. Upon this point a second record of another observer gives the date of leafing out of the Larch as April 22nd, 1897, 25th in 1898, 22nd in 1899, and 25th in 1900.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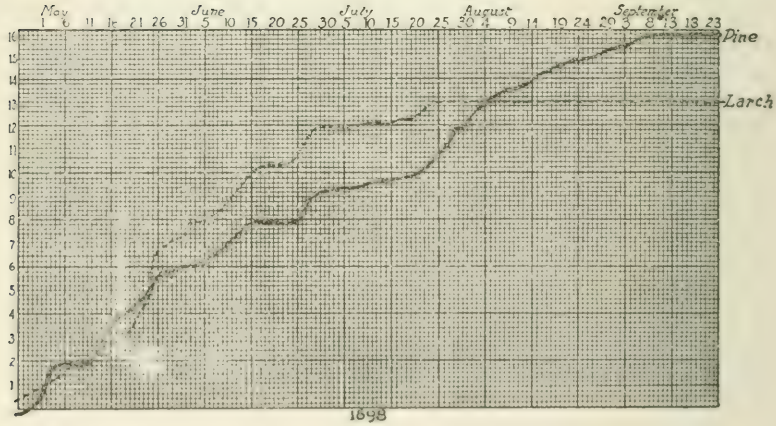
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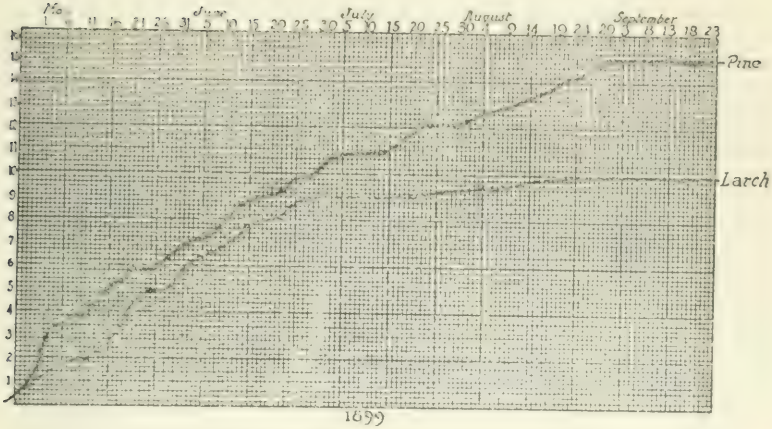
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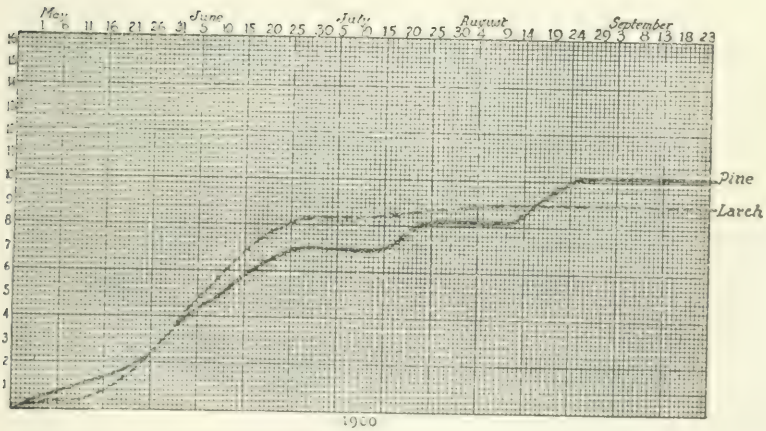
May
June
July
August
September
Pine
Larch

1900

In the annexed diagrams attempt is made to show the variations in seasonal growth. Starting with the last week in April, the tracings in dotted line and solid line show the course and fluctuations in Larch and Pine respectively. Horizontally is marked the time in five-day periods to beyond the end of the growing season. Vertically, by relatively large spaces, sixteenths of an inch of circumference increment are shown. The first and perhaps most obvious point of difference is in the greater absolute growth of the White Pine, it being credited with nearly 15-16 in 1897, 16-16 in 1898, 15-16 in 1899, and 10-16 in 1900, while the Larch shows 12-16, 13-16, 10-16 and 9-16 respectively. This result was not unexpected. Knowledge of the two species at this age, under various conditions and in various situations had perhaps already determined this point.

The second point brought out is the longer growing season of the Pine. Its growth continues well up to and into September, while the Larch grows but little, I incline to think not at all, after July, although the tracings vary somewhat in different years. I am disposed to credit this latter variation, at least in part, to the drying and curling of adhering bark plates or swelling in wet weather, causing a false appearance similating true growth. What bearing, if any, this difference in length of growing season has upon the so-called "spring" wood and "summer" wood portions of the annual ring is not clear. The wood layer of the White Pine is notably of the spring formed type, the summer formed being relatively small in amount and not sharply defined, while that of the Larch always shows a liberal portion of summer formed, the cells of which have very thick walls and are highly resinous. It is doubtful whether these two parts of the annual layer (better called primary and secondary), have such relations to the seasons as to warrant continuing to call them spring and summer formed. Certainly the summer growing tree in this case forms relatively the least amount of so-called "summer" wood, and the one which grows but little, if any, after midsummer, the most.

In order to gain light upon this point, attempt was made microscopically to examine the annual ring at two different times of the year. Small blocks were cut out of each tree on the 19th of June, 1900, and the 21st of December of the same year. These

were sectioned, stained and mounted in balsam and photographed from the microscope.

The cutting, particularly of the Larch, proved difficult with the means at hand and the photographic scale is rather too small to satisfactorily show the full ring of the year. The ring, moreover, was this year, 1900, the thinnest for the four years of observation, and the difference between the species the smallest. Although the Larch was 1/16 inch less in circumference measure, the section of the ring in the microscopic slide proved to be a trifle the thicker. The greater hardness of its summer wood and the easy separation of the wood rings from one another and from the bark gave also a less clear result. Nevertheless if correctly represented in these sections, and I believe there is no doubt on that score, the two species may, season for season, be legitimately compared with one another as to their wood rings.

It is plain that on the 19th of June the Larch in spite of its larger cells and the imperfection of the scale, had made the greater growth. At that date in each species a little less than half of the ring is still in the active condition with abundant cell contents, and neither shows any tendency to the thickening of walls, which is the visible evidence of summer wood when mature.

On the 21st of December, both had, of course, completed the year's ring, and the essential difference between the two species is marked. The Larch has greatly thickened the walls of over a third of its ring without materially flattening the cells, except a layer or two at the extreme periphery, while the Pine has slightly thickened a much smaller area, but has, in addition tangentially flattened a much larger proportion of them.

It becomes obvious from a comparison of these sections that the full history of the annual ring can be obtained only by a series of sections made at intervals during the year. The mechanical difficulties in such a study would be considerable, even then there would be the variations between the lower and upper parts of the trunk, between limbs and trunk together with such as are due to meteorological causes, as have been shown by the investigation of Hartig and others.*

* *Pop. Sci. Monthly.* 1883. 22, 204.

The Pine shows generally greater uniformity in amount of yearly growth. Perhaps also there is a little less sudden fluctuation during the season in the case of the Pine, but it is not very marked. The sharp fluctuations all occur early in the season; such as occur later are slower and less violent. It may be surmised that a correlation exists between the sharp and sudden accelerations of growth and the temperature and moisture conditions, as have been noted by Child† in the Red Maple, but no attempt was made to determine this.

Incidentally these structural and physiological differences have their bearing upon the geographical distribution of the two trees. The Larch with its high alpine, narrower range, and short and cool season location quickly forms its annual ring in two or a little over two months, while the White Pine of lower latitudes, wider range, and longer growing season is more leisurely, taking double the time and forming a thinner and softer walled wood. It is probable that this particular Larch tree (*Larix Europaea*) has passed the time of maximum yearly growth. It is not in the most favorable soil and surroundings, and is likely to mature early even though it may grow slowly and add thin rings of wood for many more years. Certainly there is nothing in our knowledge of these two species of trees to warrant expecting as long life and as great bulk of wood from the Larch as from the Pine. Experimental plantings of Larch, so far as I have known them, have been on too small a scale and either too crowded or too loosely grouped to give the best conditions. This species, however, has several advantages where quick growth and use are desired. The trees can be advantageously grown a little closer than pines; while not free from disease and injury they are but little troubled by the pine tree weevil (*Pissodes strobi*) which so grievously mutilates our young pines and spruces, destroying the leading shoot and seriously checking growth. The wood is harder, heavier, more durable and better withstands strains of all kinds. These qualities fit it for many uses where it would be sheer waste to employ White Pine. Altogether, the European Larch is sufficiently well known in various details of growth and structure of wood to warrant recommending it for artificial plantations in the northeastern states.

†For new data on this subject see this issue, p. 316 ff.

On the other hand, our native White Pine (*Pinus Strobus*) has superior staying qualities. While not as slow growing in early life as the spruces, it is considerably less rapid than the European Larch. But when the Larch has approached or even reached maturity the Pine is still growing at an increasing rate and passes its maximum probably many years later. Hence, it is capable of producing a much greater bulk of material on the same area. In the beginning of the year 1897 the Larch girthed one-fourth of an inch more than the Pine; in April, 1898, they were equal. In April 1907 the Pine exceeded the Larch by two and three-fourths inches.

This indicates that between the 40 and 50 year under the given conditions the Larch has reached its maximum rate of diameter growth, and is then surpassed by the White Pine.

It may be worth while to call attention to the "double ring" which appears clearly on the section of the White Pine, and to put the old query, apparently still unanswered, what determines the formation of the "summer wood," and what gives rise to a double ring? Is it varying bark pressure? And furthermore, have we absolute proof that the condition and structure of the ring remains fixed as at the end of the year, or may not after all a change take place, obliterating for instance such double rings?

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"AVERAGE LOG" CRUISE.

So many and varied are the duties incumbent upon the forester under present conditions in the United States, and so great is the scope that his training is popularly supposed to cover, that it is often with difficulty the younger men in the profession meet the initial tests imposed upon them. This is especially true in the first associations between the young forester and the lumberman. Often the ability of the forester is judged by how he acquits himself at his first test and from its result the whole cause is either belittled or fostered. The lumberman will often listen interestedly to statements and theories and will then propound a trite question, based on his exact knowledge and testing to the extreme the accuracy of the forester's snap judgment. How often, on a tour of inspection with a lumberman, is the conversation interrupted by— "How much will that tree cut?" "What would you place as the average yield of the slashings we are now in?" "What will this tract go to the acre?" And on the ability of the forester to assume the position of an expert cruiser, is largely judged the value of the practice that he is recommending. Lucky is he who can closely approximate the facts as known to the lumberman, for his case is nine-tenths won.

In the general condition of our American forests no more difficult practical test is imposed upon the forester than to correctly estimate the volume of the standing timber. Our national, state, and private data for volume are entirely inadequate to cover the multitude of variations in our forest growth. Specialized, they are good; generalized, they are often most misleading; individualized, they are at times ludicrous. Thus, to devise a method of estimating that will meet the exigencies of all conditions it is necessary to leave the beaten track and to enter the field of an adaptable table of volume.

For two years the writer has been examining and purchasing timberlands on the Pacific coast. Probably two million acres have been looked over and group-estimated. Some 200,000 acres have been carefully estimated by him or by men under his supervision. The "average log" method of estimating evolved in that

experience, but which is now far from perfected, permits of many objections on practical and theoretical grounds. Nevertheless it is simple, and admits of a surprising degree of accuracy, as shown by actual woods and log scales. To obtain a detailed estimate of a timber tract the work is grouped under two captions, (1) field work—collecting data, (2) office work—computing data. In order to better understand the method it may be well, however, to first consider the underlying principles and theories governing the work.

I. Principles.

It is readily apparent to the forester that work in complicated forests of mixed species, such as exist throughout the United States, is greatly handicapped by the use of volume tables prepared in other localities. These tables can apply only to the given species for which they were prepared. Furthermore their error under extreme conditions, or if used in individual cases (incorrect use), is often 75 per cent. or even more. Thus in a mixed stand of five merchantable species, five distinct volume-tables must be used, each subject to wide error. It is therefore impracticable, often impossible, in the limited time allowed to examine a tract, to correctly estimate the stand on this basis. Furthermore a large force of well-trained, experienced cruisers at correspondingly high rate of wage would be needed to do the work by the ordinary method of cruise. It was therefore necessary to devise some means for treating all trees uniformly regardless of species, and to apply some system of reducing their contents readily to board feet.

For a long time no good method for doing this was found. Many theories were worked out and discarded. Finally an old cruiser, whom the writer happened to meet, suggested the keynote in a then unheard-of formula for obtaining the scale of the average log of a tree. This formula, to the writer's great interest is presented as a rule of thumb in Professor Graves' *Forest Mensuration*, p. 153, and is as follows: Subtract 60 from the square of the middle diameter and multiply by 0.8, thus giving the contents in board feet of the average 16-foot cut in the tree. The volume of the tree in board feet is then easily calculated by multiplying the volume of the average log by the number of 16-foot logs in the tree. This formula was checked on many trees of

varying forms and species, and the writer has yet to find a case where the results given do not closely coincide with the actual scale. The results thus found are necessarily based on the supposition that the tree is sound. All cull deductions are made later from cull scales or tables based on previous experience.

With the fundamental principles given, the application naturally evolved. For expediency in the woods the trees should be measured at breast-height. Some hypothetical top diameter or taper must be chosen and heights determined, to permit office computation. In deciding upon top-diameters the personal equation of the forester is involved. His decisions must be based on species, form, economic conditions, etc. Aside from the commercial limitations, which must be known by the forester, the other points are practically all embodied in factors of site. These factors may be readily approximated by a general survey of the tract in question, the height growth being the fundamental consideration to be noted. This may be done in one or two days, and a few hours at night will complete the tables necessary. If the forest is homogeneous one table will suffice. If conditions vary greatly, make tables to match.

As a concrete example the writer will cite the table that he is now using for work in some 40,000 acres of exceedingly tall "yellow fir" (*Pseudotsuga taxifolia*).

Average Log Table.

D. I. B. at B. H. inches	Vol. Feet B. M.	D. I. B. at B. H. inches	Vol. Feet B. M.
14	83	25	290
15	100	26	315
16	116	27	339
17	132	28	364
18	148	29	386
19	170	30	413
20	183	31	444
21	206	32	472
22	226	33	501
23	244	34	527
24	266	35	557

D. I. B. at B. H. inches	Vol. Feet B. M.	D. I. B. at B. H. inches	Vol. Feet B. M.
36	585	44	865
37	625	45	904
38	658	46	932
39	686	47	960
40	721	48	989
41	757	49	1018
42	798	50	1047
43	834		

After the preliminary examination of the tract, the following top diameters were decided upon. Fifteen inches* was taken as the lowest diameter breasthigh for the estimate and 12″ its corresponding top diameter (short piling). For 45″ D. bh. a top diameter of 24″ was chosen. The intermediate middle diameters for each inch D. bh. class were figured from a plot on cross-section paper.

In order to insure that margin of safety desirable in any estimate, the ratio between D. bh. and top diameters (as just stated) was figured by straight averaging instead of by the (proper) use of the areas of circles. Thus the middle diameters of the average log table as used, represent a double means of safety, in being less than the mathematical average between the end circles, and also in that the tree form is herein treated more as the frustrum of a cone than that of a paraboloid. As matters of interesting comparison the following results are presented.

In result I the values as given are from the table actually in use.

$$\text{I.} \quad V=(D^2-60).8$$

D at bh	D at T.	Av. D.	Board feet	Logs in tree
35″	20″	27.5″	557×6=3342 board feet	

In Record II the same form is cubed as the frustrum of a paraboloid.

$$\text{II.} \quad V=\frac{B}{2}h=4.4315 \text{ sq. ft.} \times 96=425.424 \text{ cu. ft.}$$

*All diameters given are measurements inside the bark. Fir bark varies too much to allow of other standards.

For reducing this to board feet, a co-efficient of 8 (8:12) is used in rough practice for the large circular and top saws, and 9 for the ordinary band. With very large logs, in canting for U. G. flooring, and balance in dimension stock; and sawing with most improved bands 10 is sometimes allowed. Thus:

8=3403. board feet; 9=3829. board feet; 10=4254. board feet.

Actual scale by Spaulding rule of 6-log tree 35″ D. i. b. at D. bh. to 20″ top gives the following result (III):

Log.	Scale Diameter.	Board Feet.
1	33	796
2	31	701
3	29	612
4	27	528
*5	24	412
6	20	276
		3,325

Based on middle diameter reduced by 1″ for taper and scaled by Spaulding rule, the result IV is obtained:

$$\text{Middle diameter } \frac{(35''-20'')}{2}=27.5'' \quad 28'' \text{ log}= \quad 561$$

$$27'' \text{ log}= \quad 528$$

$$2) \quad 1087$$

$$544$$

27.5=approx. 544; hence the 6 log tree=3264.

Comparing the methods, we find then:

Method.	Board Feet.
I.	3342
II.	3403— 8 3829— 9 4254—10
III.	3325
IV.	3264

* Limbs.

It is interesting to note the volume for such a tree as given in a Forest Service volume table prepared by Mr. E. T. Allen in Cowlitz county, Washington. Herein a tree 35″ outside bark at breastheight, (D. A. B.) cutting to a 12″ top, scales 2545; to a 16″ top, 2295 board feet. The measurements here, however, were taken outside the bark at breast height. Figuring bark at 5″, about right for good Yellow Fir of this size, a 40″ tree in Mr. Allen's table is comparable with the 35″ tree under consideration. Thus a 40″ scale 3340 to a 12″ top, and 3,070 to a 16″ top. The Cowlitz growth is similar to the growth for which the Average Log table was made. Compare with this Cowlitz, or localized volume table, the more general one of an average of six counties in Washington cutting to about 26″ top diameter (also from Mr. Allen's work)—36″ tree (no 35″ class is given), 1,962; 40″, 2,496 board feet. In order to approximate the volume of the Cowlitz tree (3,340) a 46″ tree from the general table is necessary (3395). It will be noted that the varying of the cutting limits is partly responsible for these differences. Still it would not be difficult in Cowlitz county to find areas where a 35″ (D. i. b.) tree would show 8 logs to a 20″ top. In this case we would have by the average log table 4,456 feet, against a possible 3000 feet for a tree of corresponding diameter read from the general table.

Referring again to results I, III, and IV, it will be remarked that I is in the excess. This seems dangerous. But comparison with result II shows its safeness, and also that it is close enough to prevent any "errors of omission" in passing by a good tract because of an underestimate.

On this principle a complete table of volume is figured for the range of diameters and heights encountered in the tract to be estimated.

It is desirable, from many points of view, in the estimate of a tract to procure data of the distribution of the stand and also for crude maps, etc. For this the "forty cruise" is well adapted, and to this has been fitted a further adaptation of the full circle method. Where the U. S. rectangular surveys prevail the best system for a detailed cruise, to the writer's mind, is as follows:

Given a section of land (640 acres) to estimate, the crew consists of one tally-man, and one line-man, who also paces the distance. The ground has been viewed previously, though perhaps

only from a distance, and the trend of the topography determined. The crews are instructed to cross this trend, thus getting a truer average of stand as influenced by site, in cañon, on bench, slope and ridge. The line-man is supplied with a pocket sight compass and a small tally register to count his paces. The start is made from a government corner, and the section line that parallels the trend of the country is followed.

A government "forty" is ¼ mile square, and the line-man knows that it takes 500 of his steps to travel this distance (250 double steps, commonly known to the western cruisers as "D. Ps." [double paces], is the usual unit of measure for ¼ mile). The method of pacing is usually to start with the left foot, and press the plunger of the register, which is held in the right hand, each time that the right foot strikes the ground. The line-man thus paces off 125 D. Ps. along the section line to the middle of the boundary of the forty, and then turns a right angle. A circle that contains an acre is slightly less than 118 ft. in radius, or approximately 23 D. P. The line-man, therefore, takes his sight and starts. As he registers 2 paces, he calls "Back," and the tally-man notes a tree, bush, or well-defined mark to serve as an outer limit, to the rear, for his circle. The line-man on reaching 25 D. Ps. calls "Center" and the tally-man comes up. The line-man then proceeds to 48 and stops after calling "Fore." Thus the tally-man is at the middle of a line 46 D. Ps. in length. He has a sight 23 D. Ps. to the rear, and the line-man is 23 D. Ps. in advance of him. It is thus an easy matter for him to swing his eye in a circle covering an acre and to count the number of sound merchantable trees therein. These he tallies in their proper columns in his book. He then studies his trees and determines ocularly the average or sample-tree on the acre. This he measures with a diameter-circumference tape, and then deducts for the thickness of the bark. The diameter inside the bark at breast height he then records. Given this, he knows to what top-diameter limit he can go. He then steps back to the center of the circle, or to any convenient point, and estimates the number of 16′ logs to the given top diameter. Herein enters the judgment of the tally-man. But he soon learns to size his trees very well, and if he errs at all it will be on the safe side. His notes might then read thus:

Section	Town	Range	Date
	First Forty	SE⁴ SE⁴	

Sta.	Fir.	Red Cedar.	White Cedar.	Hemlock.
1	15 7/38	2 4/27	8 4/22	1 6/20

Thus there are on the first circle counted fifteen fir trees whose average merchantable length is seven logs, and whose average diameter inside the bark at breast-height is 38″.

The count completed the line-man steps off four more D. Ps. to 52 and again calls "Back." Then comes "Center" at 75 and "Fore" at 98. The count is taken at 75. This method is continued across the forty, counts being taken with centers at 25, 75, 125, 175 and 225 D. Ps. At 250 D. Ps. the line of that forty is crossed and the next forty entered. While facing the distance in thus sub-dividing the forty, the line-man takes such topographical and lumbering notes as may be required. As the claim or forty is completed, the tally-man notes the "Claim Factor," C. F. This is his own idea as to whether or not he has been travelling through a fair average of the forty. If he decides that he has he notes C. F. O. K. But if he thinks that for some reason, which he states in notes, the five counts do not represent a fair average he expresses this relation by, say, C. F. $\frac{1}{8}+$ meaning that to the stand computed from the five actual counts must be added $\frac{1}{8}$ to get the full estimate. With C. F. $\frac{1}{8}-$, that amount must be deducted. If there are any prairies, burns, or barrens on the forty their area and location are noted. The C. F. however, applies only to the timbered areas, the open spaces are taken care of in the computation. Second growth is also noted, and also items of interest to the forester according to his directions. When the day's work is completed the sheets are sent to the office.

III. Office Work.

The computation in the office from the data for each forty is exceedingly simple. It amounts to merely substituting for the fraction, expressing the form of the tree, the board feet in the tables for the corresponding diameter and log-lengths. This sample tree volume is multiplied by the number of trees to the count, and the stand for that species is entered in its proper place. Each

count and each species is thus treated. It will be readily seen that on a full forty, five acre-counts represent $\frac{1}{8}$ or $12\frac{1}{2}$ per cent. of the area as actually scaled. Therefore, with C. F. O. K., the total of the five counts has merely to be multiplied by 8, thus giving the total stand of each species on the forty. These totals cross-footed into a grand total give the entire merchantable yield of the forty. If the forties are not full for any reason, *i. e.* fractional government lots, presence of burned areas, or grass land, the average acre is found from the counts and its value multiplied by the acreage of timber in the forty. Changes in totals due to + or — in the C. F. are also made accordingly.

The speed and cheapness of this method, coupled with its accuracy, greatly lends it to a wide trial. There is also an advantage of secrecy, in that the tally and line-man do not know what the full estimates are. Good woodsmen may be readily secured in many places where experienced cruisers are at a very high premium. In ordinary "going" two men can cover 320 acres a day in the heavy coast fir, 480—800 acres in mountainous pine lands, and occasionally up to 1280 acres in flat, open, pine lands. The cost of these men will rarely exceed $6 and expenses for the crew, and will occasionally go as low as $4.50 per day. An experienced cruiser commands $10 or more, and his one or more line-men $2 to $3 per day. Furthermore, they cannot cover ground as fast, and it is doubtful if they can do it as well as the cheaper crew under the system just outlined.

When once a man becomes acquainted with this method he can easily carry with him the average size of the trees passed. This, on a rapid examination, will be constantly shifted and adjusted, but with very little attending mental effort. It is merely averaging and comparing, two duties that the eye fulfills daily. Counts on acres over a tract may be made even while strolling along on a horse. A small tally register will quickly and safely record the trees, and it is only necessary to remember the number of counts in order to easily secure the average acre. The eye soon gets to measure the 118 feet of the radius and the count may be made about as fast as the head may be turned. Experience will soon tell of diameters, and practice in computing will carry a clear recollection of the scale of the average logs. Thus when a snap judgment is requested on the contents of a tree, the stand on an

acre of virgin timber or even of cut-over, or, perchance, of the forest of the last six hours, the answer will be forthcoming immediately, and it will not be far from the facts of the case.

The system of the average log, with minor changes, has been employed by the writer for about a year. Many are the objections that may first be raised regarding the volume theory. On short, quickly tapering trees the results do appear large against log scale. Still the ordinary log scales do not approach the mill scale on short-boled timber. The true test of the system will be from the woods directly to the results on the grading table. As yet the writer has had no opportunity for checking in this way. In this, time alone will tell.

A year's use, and that in limited practice, is, however, no criterion on which to judge the value of the system. New objections are bound to be entered. The writer would request all foresters who can, to utilize the system, and to report wherein the tables may be improved. New formulas may be devised that will more closely cube the average log. Criticism is wanted about all things, and suggestions desired on all phases of the system. The more the "Average Log" method is used, the more severe will be its "try-out," and therein only may the system be perfected—if it proves at all worthy of the same.

W. J. Ward.

THE FOREST LAWS OF CALIFORNIA.*

During the 35th session the Legislature of California enacted forest laws which were approved by Governor Pardee on March 18, 1905. They mark the renewed adoption by California of a movement to perpetuate the forest that has found favor within recent years by the National Government and by a majority of the States. Here, as elsewhere, legislative action followed a period of propaganda for the purpose of creating a realization of the need of pursuing methods favorable to forest preservation. The progress of the agitation work was marked in this State first by the passage of an act in 1885 entitled, "An act to create a State Board of Forestry and to provide for the expenses thereof." This board was functionally a bureau of education. It issued three reports which were botanical in character. In 1887 it was endowed with police powers and given an appropriation of $29,500. In 1893, however, this board was abolished.

From 1893 to 1903 there was no surface indication of the undercurrent of feeling in favor of forest preservation. Yet this period was one of marked need and of rapid development along other lines. It was the decade during which the lumbermen from the Lake States and Southern pineries flocked to California to invest in timberlands, and during which time the State disposed of the bulk of its sole forest possessions by the sale of school lands for the ridiculously low price of $1.25 per acre. Then, in 1903, those in favor of forest preservation made another stand and secured the passage of an act empowering the State Board of Examiners to contract with the Federal Bureau of Forestry to study and report on the forest resources of the State with recommendations regarding the best means of conserving them. This study has been in progress ever since, but will end on July 1st with all its objects attained. Before it had progressed a year, enough was learned to warrant the recommendation of a policy for the State to pursue with reference to her forest lands. These recommendations were submitted by the Bureau of Forestry in the form of a bill which provided for the appointment of a State

*A paper read at Petaluma June 7, 1907.

Forester and two Assistant State Foresters, and in addition a field force of ten district fire wardens. The bill made provision for technical assistance to forest owners in the management of their property, advisory aid to those desiring to establish forest plantations and included punitive restrictions in the use of fire on forest land. These latter were to be enforced by the fire wardens under the supervision of the State Forester.

This bill failed of passage in its original form chiefly because the Legislature was not assured the time was ripe for such an elaborate system, and because of an objection, ill-grounded in my opinion, to the policy of making the taxpayers as a whole bear the burden of protection more or less local. Some men doubted the necessity or practicability of any action; others felt that the work would be educational at best. A compromise was effected at the last moment by hastily cutting out of the bill nearly all the provisions for a field force and leaving only the means of maintaining an agitation bureau at Sacramento, with which local interests could co-operate if they should see fit.

The result was the Act of March 18, 1905, under which State forestry work is being conducted. Its underlying principle is that the State's duty ends with urging and permitting its interested industries to protect their forest resources at their own expense; and the machinery it provides for this purpose in the insufficiently altered detail of the original bill, devised for a wholly different system. But although this was as far as the Legislature was willing to go in the beginning, the apparent policy expressed was not expected to serve permanently. The measure was intended to be experimental; to provide means by which the people and the administration could learn by mutual experience the possibilities of the movement and the equitable share of expense to be borne by each. The knowledge thus gained was to guide the enactment of new laws.

Forestry work under the new law began on July 12, 1905, when the Board of Forestry was organized and a State Forester was appointed. The general policy for early work consisted of a lively campaign against forest fires, because it was recognized that they constitute the chief destructive agency in California, and until their prevalence is decreased activity along the other two lines is of doubtful practicability. Education and publicity

were aimed at first, rather than rigid enforcement of the penal sections, both because no machinery for the latter existed and because it was not deemed advisable to risk making the movement unpopular in the beginning.

During the following year it was possible to reap some of the benefits created by the agitation of the first year. Among the achievements can be noted the co-operation of ten counties which appropriated sums ranging from $250 to $1,500 to pay the claims for salaries and expenses of the fire wardens acting within them. These ten counties had 103 fire wardens. There were 128 employes of the Forest Service, acting under State appointment, who did good work in enforcing the law on private lands within, and contiguous to, the forest reserves where their Federal authority did not apply. Their claims were paid by the Forest Service. In addition 136 men accepted appointments as volunteer fire wardens to protect their own or their employer's interests. These men either bore their own expenses or were paid by their employers. Of all the fire wardens appointed none received any money from the State.

From the fire wardens and other sources it was learned that 120 forest fires, exclusive of those in the forest reserves, occurred last year. The fire wardens worked on 76 of them. More than 650,000 acres of forest land were burned over, destroying in some cases only the vegetation, in other cases houses, stock, and valuable timber. In every case, however, the loss to the State was a real one, for it meant either the direct destruction of taxable property or the lowering of productive power. During the summer 24 arrests were made for violation of the forest laws and 16 persons were convicted and fined.

It may be said then that the forest laws are very useful. On the other hand, this cursory view of the situation would be very misleading, did it not admit great need for their improvement, both in detail and general scope. Their object will not be attained without still further assumption of responsibility by the State, for the theory of voluntary co-operation upon which they are based is too ideal. The indifferent element of the population is still too large. The present system leaves the regions where indifference predominates unprotected, whereas it is the one really in greatest need of protection. Let me illustrate by citing the ob-

stacles to be overcome in securing county appropriations as a means of preventing fires. This condition obtains excepting in the southern counties:

(1) The mountain counties which are the timber-bearing ones in California are sparsely settled; are assessed highly already for their necessities such as roads, bridges, buildings, etc., and hence are literally too poor to spare any of their funds to protect their forest property.

(2) The valley counties, which are our agricultural and horticultural sections depend for lumber, fuel wood, fence material, stakes and even for the water to grow their crops on the protection of the forests in the mountain counties. Yet the valley counties cannot appropriate money to be used in the neighboring mountain counties even if they would.

(3) Then consider the county of San Francisco. The cry is heard that the city should not be taxed to protect the forest, but I tell you that it should. Does not the city of San Francisco use mountain water? Do not the inhabitants of San Francisco delight in excursions through the mountain forests? Is the city not dependent for existence itself on a plentiful supply of lumber for building purposes? It is useless to attempt to solve this State-wide problem by local applications. The forests of the State must be protected by the State if they are ever protected. I believe that the State should have an appropriation for forestry purposes large enough so that it could meet the counties half way. Let the State and each forested county bear jointly the expense of maintaining one fire warden, who shall have no other than patrol duties; who, in case of a fire shall take active charge, summon men, secure provisions, etc., and at other times shall go about among the people instructing them regarding the forest laws, securing their confidence and enlisting their support. The men called upon by a warden should be paid for their services from the joint appropriation made by the State and the county in which the services are performed. At present the wardens have the authority to warn men out to fight fire and they may be fined if they refuse to go, yet there is no fund from which they can be paid unless the county bears the expense. The State cannot justly refuse to accept its share of this burden.

There is just one other feature of the forest law I want to call

to your attention. It is provided that there shall be two Assistant State Foresters, who shall receive a salary of $1,200 per year. Whether the requisite is general address and ability to enlist confidence and co-operation in a new movement or, as it will be more and more, technical and practical training in forest work, it cannot be obtained at this price. It is absurd to leave the solution of a problem involving millions, and by its nature requiring enterprise and originality, largely to depend upon the impression made by men who must be secured for less compensation than is received by a minor clerk or mechanic. Unless this situation is improved the State will fail, at least partially, to meet the demand for assistance which it is trying to encourage.

Owing to the low salary it has been found impossible to secure technically-trained men as assistants, yet technical training in forestry is as essential to the forester as the study of medicine is to the physician. For example, before giving advice in planting, except the tract is small and in a well-known region, it is necessary to visit the tract and make a close study of the many natural factors important to tree growth. A tract of forest land, real or potential, is to the forester what a patient is to the physician, and the former must be quite as sure as the latter that the treatment recommended applies to the particular case at hand. "Absent treatment" is unsafe.

To prove that there is a call for this work I need only state the fact that since last August I have received applications from 30 landowners for advice in planting a little over 75,000 acres of land. Planting plans for 65,000 acres have been made in this period and general advice has been furnished for much more. In most cases the examinations have been made too hurriedly, however. This situation will not be fully met until a more liberal salary permits the securing of technical men who can be relied on to do part of the work.

These improvements can be secured if there is a universal demand for them, and I look to the California Promotion Committee to continue its good work in creating this demand and focussing it on the next Legislature.

Geo. B. Lull.

TREATMENT OF HARDWOOD LANDS IN SOUTHWESTERN CONNECTICUT.

The purpose of this article is to outline in a preliminary way the methods of treatment which appear the best adapted to the hardwood stands typical of southwestern Connecticut. Emphasis has been placed especially on theoretical considerations, but since market conditions in this territory are most excellent, the practical and the theoretical are both attainable in the average case.

The forest products most in demand are telephone and telegraph poles, piles, and ties, making possible comparatively low rotation. Cordwood, the chief output of thinnings, except at distances of over six miles from a market, can be disposed of profitably.

For the owner who has only a temporary interest in the forest, no change from the present system is advisable. But where the land is held permanently it is believed that the quantity and quality of the yield can be best increased under some such system of management as that here outlined.

As yet but little definite data on the results of treatment have been secured. This is but natural, as the scientific management of Connecticut woodlands is just beginning.

So the exact results of many of the operations advised cannot be accurately stated. As more information is gathered regarding the results of treatment, better methods may be developed.

Southwestern Connecticut is essentially a region of mixed hardwoods with chestnut, oaks, (red, white, black, scarlet, chestnut,) hickories (pignut, mockernut, shagbark) and soft maple as the leading wood producing species.

The composition of the forest may range from stands of chestnut, oak, hickory, or maple to complex mixtures containing 10 or 15 commercial species. Mixtures are much more frequent than pure stands. Owing to the fact that the woodlands have been cut over again and again and usually cut clear, timber of a large size is rare. As a further consequence of the clear cutting the present stands are chiefly of sprout origin, while the trees in

a single stand are of practically the same age. Surface fires running at short intervals—often annually—over the same area are responsible for serious injuries to the forest. But few stands can be found which do not show the effects of fire, either in poor soil conditions and lack of thrifty seedlings and saplings, or in the scarred and hollowed butts of mature trees. The amount of fire damaged timber which dies each year from the direct injuries or the subsequent attack of fungi is undoubtedly large, though no definite estimate can be made at this time. Were these surface fires stopped the condition of the forest would improve rapidly.

An even aged mixed forest of sprout hardwoods showing too plainly the harmful effects of forest fires characterizes the wooded areas of southwestern Connecticut. The treatment for this particular type of woodland only is here considered. Without doubt these sprout stands of mixed hardwoods form the prevailing forest type, usually referred to as the Mixed Hardwood Type. Before taking up the detailed consideration of its management it may be well to enumerate the other chief types and to distinguish them from one another.

On swampy land stands of soft maple or of mixed hardwoods thrive, but they differ from the mixed hardwood stands already described by the absence of chestnut and hickory and most of the oaks, which give place to species capable of growing in excessive moisture. The swamp hardwoods thus furnish a type by themselves needing special treatment.

Another very extensive type, the Old Field Type, is found on fields formerly under cultivation or in pastures which are now growing up again to forest. The trees are of seedling origin and vary greatly in age. These two points, together with the presence of red cedar, and grey birch, serve to separate such stands from our main type of hardwoods. The old field type at first contains but a small percentage of chestnut, oak, and hickory; but gradually these species increase in proportion and by their more enduring qualities drive out the grey birch and red cedar. They tend gradually to approach the mixed hardwood type in character and after being cut over once, change into this latter type.

Besides the main types, other minor types occasionally exist.

Stands of the mixed hardwood type may be separated into two classes for the purposes of this article:

1. Untreated stands first taken under management when 30 or more years of age.

2. Stands from early youth under forest management. The general method of treatment for the two classes is the same, but as the details differ somewhat each class will be considered separately.

I. Untreated Stands First Taken Under Management When 30 or More Years Old.

In an untouched forest allowed to grow naturally a vast number of inferior trees accumulate, ranging all the way from individuals already dead to others just becoming over-topped. That the competitive struggle for existence in such crowded stands is intense is well known to every forester. Nor is it necessary to enlarge on the need of, and benefits to be derived from thinning the stand. The point to be emphasized is that, while even in well managed forests dead and suppressed material gradually gathers between thinnings, yet in the forest which has remained untreated until middle age, the accumulation of these classes of trees is much greater. Indeed the presence of large quantities of dead and suppressed trees may serve to characterize untreated hardwood stands.

This characteristic indicates the line along which treatment must be first directed. The stand must be freed of the excessive quantity of inferior trees and improved by being brought into condition for healthy rapid development.

A preliminary cutting of this nature is a true thinning, but since the stand has previously been untreated the inferior material has accumulated and exceeds in amount the quantity which would come out from a stand of the same age, but regularly thinned in the past. To express the same idea in another way, a preliminary cutting and thinning made in accordance with European standards, whether of grade A, B, C or D, removes, in taking out the same classes of trees, a higher percentage of the total volume than is laid down in European textbooks for the different grades of thinning.

In many cases a preliminary cutting is more than a thinning, in that occasional gaps may be made in the canopy by removing badly diseased trees. It is then an *improvement thinning* rather

than a *thinning* in the more restricted and technical sense of the word.

To illustrate the difference between preliminary cuttings made (1) as an ordinary thinning, and (2) as an improvement thinning, tables 1 and 2 have been prepared, each one representing one-quarter acre. Table 1 was taken in a stand about 40 years in age which had been but little damaged by fire, insects, and fungi. Table 2, on the other hand, represents a stand approximately 10 years older which has suffered severely from fire and the subsequent attacks of fungi. In the former stand a preliminary cutting (thinning) was made, taking out dead, suppressed, overtopped and a few intermediate trees. In the case of such tolerant species as beech, black birch, and hard maple certain suppressed and overtopped individuals were left, provided they did not interfere with the main stand. The purpose of the cutting illustrated in Table 2 was to remove dead, suppressed, overtopped, and part of the intermediate trees, but also to take out all the badly damaged trees which probably would not survive until the next cutting (10 years hence). Thus openings in the crown cover were allowable and as a consequence (although the cutting did not have this end in view) a certain amount of seedling reproduction may be expected.

At first glance the two tables seem to show similar thinnings. But on observing the stand of 7″ and over D. B. H. we find that out of 50 trees in Table 1, 9 are removed, or 18%, while in Table 2 out of 43 trees 11 are cut, or 26%, indicating a much heavier cutting in the main stand in the improvement thinning than in the ordinary thinning. The number of trees per plot in Table 1 is more than twice as great as in Table 2, due to the difference in age, and to the fact that on the latter plot more frequent fires have hastened the death and decay of small trees, and also because small beech, birch, and hard maple, tolerant species and able to grow under a cover of oak and chestnut, abound in Table 1 but are lacking in Table 2. The number of trees 7″ and over in D. B. H. corresponds quite closely on the two plots. The figures at the foot of Table 1 serve to support the statement in a previous paragraph that a preliminary cutting in an untreated stand removes a larger per cent. of the volume than the amount usually credited to such a thinning. For this

thinning taking out dead, suppressed, most of the overtopped, and a few intermediate trees, without breaking the cover would be classed as a Grade C thinning (see QUARTERLY, Vol. — p.—), and theoretically would remove not over 15% of the volume of the stand. As a matter of fact fully 29% was cut out in this stand. Probably 25% of the volume represents a fair average.

The character of this style of cutting is well brought out in Table 3, which gives the stand before and after cutting with the trees tallied by crown classes. The figures were taken in the same type of stand as those of Table 1, the two plots lying within 100 yards of each other and representing the same thinning. It is seen that all the dead and suppressed trees were removed, together with more than half the overtopped and about 1/3 of the intermediate trees, representing 23% of the total volume. No dominant trees were cut. The large percentage of overtopped trees left after the cutting are composed mostly of hard maple and black birch.

Where the preliminary cutting is largely an improvement cutting the volume per cent. removed will vary greatly, depending chiefly on the extent to which the stand is damaged, probably never falling below 20%.

Five to ten years after a preliminary cutting the average stand will need further treatment. Whether another thinning or a cutting to secure reproduction is in order will be determined by the age of the stand and by the length of the rotation on which it is managed.

With the prevailing market conditions a rotation of more than 80 years is inadvisable for the average owner; and where stands are taken under management at 30 years of age or younger, a 60 to 70-year rotation is sufficiently high. This would hold especially for mixed hardwoods with a considerable percentage of oak. If chestnut occurs pure or in predominating amount, a much lower rotation, say 40 to 50 years, can frequently be used to advantage.

Whatever the length of the rotation a time will finally come when the question of harvesting the old crop and providing for a second crop must be considered. The customary method in the past has been to cut clear, harvesting the entire crop at one time and obtaining reproduction by sprouts. Under certain circum-

TABLE I.

Diameter. Breast High. Inches.	Chestnut.			White Oak.			Black Oak.			Birch.			Beech.			Maple.			Hickory.			Poplar.	
	Total.	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.	Left.	Total	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.
2	.	.	.	13	9	4	2	2	. .	14	10	4	44	10	34	23	16	7	1	. .	1		
3	6	5	1	15	12	3	8	8	. .	10	7	3	20	2	18	19	13	6	1	1			
4	5	5	. .	2	2	. .	3	3	. .	. .	. .	. .	3	. .	3	4	3	1	1	. .	1		
5	6	4	2	8	5	3	4	3	1	1	1	. .	2	1	1	4	2	2					
6	11	4	7	2	. .	2	6	1	5	. .	. .	. .	1	1	. .	1	. .	1					
7	5	2	3	1	. .	1	2	. .	2														
8	7	. .	7	. .	. .	. .	2	1	1	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1	1
9	7	. .	7	. .	. .	. .	2	1	1														
10	11	1	10	. .	. .	. .	4	1	3														
11	3	. .	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1	2
12	2	. .	2	. .	. .	. .	1	1															
13	1	. .	1																				
Totals,	64	21	43	41	28	13	34	21	13	25	18	7	70	14	56	52	34	17	3	1	2	2	2

Total number trees, ...290
Total number trees cut, ...139
Total number trees left, ...151

Total stand (estimated) = 9 cds.
Amount cut (actually cut and stocked) = 2.6 cds.
Per cent. of thinning in volume = 29.

TABLE II.

Diameter. Breast high, Inches.	Chestnut.			Oak.			Maple.			Tuliptree.			Hickory.			Others.		
	Total.	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.	Left.	Total.	Cut.	Left.
3				6	5	1	16	12	4							4	1	3
4	3	3		12	8	4	4	3	1				1		1	1		1
5	3	3		6	3	3							1		1			
6	3	2	1	6	2	4							1		1			
7	4	2	2	6	1	5				1		1						
8	3	2	1	5	1	4				1	1		1	1				
9	6	2	4	7		7												
10	2		2	2	1	1												
11	2		2	1		1												
12				1		1												
13				1		1												
Totals	26	14	12	53	21	32	20	15	5	2	1	1	4	1	3	5	1	4

Total number trees, ... 110
Total number trees cut, ... 53
Total number trees left, ... 57

Total stand (estimated) = 9 cds.
Amount cut (actually cut and stocked) = 2 cds.
Per cent. of thinning in volume = 22.

TABLE III.

Species.	Original Stand.					Cut.					Left After Cutting.				
						* Crown Classes.									
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
						Number of Trees.									
Chestnut,	23	3	6	2	12	0	1	4	2	12	23	2	2	0	0
Oak,	27	6	10	9	20	0	2	9	9	20	27	4	1	0	0
Other,	7	26	80	26	17	0	9	38	26	17	7	17	42	0	0
Totals,	57	35	96	37	49	0	12	51	37	49	57	23	45	0	0

* Crown classes. Total stand (estimated) = 7 cds. Amount cut (actually cut and stocked) = 2 cds. Per cent. of thinning in volume = 23. 1 = Dominant. 2 = Intermediate. 3 = Overtopped. 4 = Suppressed. 5 = Dead.

stances this works well, in other cases poorly, as will be explained later.

In considering methods of reproducing stands, a distinction should be made between (a) chestnut stands and (b) those containing other hardwoods with but little chestnut.

Chestnut stands are best adapted for reproduction on a clear cutting system (simple coppice). Owing to the fact that chestnut sprouts so thriftily, good reproduction of this character is assured. Then again, in many localities it is well nigh impossible to secure chestnut seedling reproduction. Between man, squirrels and insects, the nuts have difficulty in germinating and producing seedlings. So the leaving of a few seed trees after cutting is practically useless in securing seedling reproduction. If a reproduction cutting or a partial cutting of any sort is made, the sprouts which start from the stumps of the felled trees cannot develop unhindered. Chestnut being an intolerant species the shade of the remaining stand stunts the growth of the young sprouts and may finally kill them.

As there is no hope of sufficient seedling reproduction, efforts to secure it should be abandoned and directed toward getting the best possible sprout reproduction. This can be attained in no other way so well as by clear cutting.

Whenever a clear cutting system is used, the cutting should be done very late in the fall, in winter, or in early spring.

With mixtures of oak, hickory, etc., seedling reproduction is attainable and the system of reproducing such stands should aim to secure the largest possible percentage of seedlings in the second crop. The fact that the stumps, of the older oaks especially, fail to send out any sprouts after a cutting makes necessary the presence of seedling reproduction. Under the employment of a clear cutting system no seedling reproduction of the valuable species comes in, and many of the stumps sprout poorly or not at all, the result being shown in frequent blanks which gradually seed to poplar and grey birch. The removal of the old stand in a series of reproduction cuttings furnishes the proper treatment. It is unnecessary to enter into a discussion of the theory governing reproduction cuttings. Suffice it to say that by the average owner two or at most three cuttings at intervals of

5 to 10 years, depending on the rapidity with which seedlings spring up, should be used in cutting off the mature timber.

Often after a preliminary cutting (improvement) as previously noted, conditions favorable for seedling reproduction are created. Where such a cutting has been made late in the rotation it may serve as a preparatory reproduction cutting. But frequently when the preliminary cutting takes place early in the rotation it will be necessary to allow the stand to close up and suppress the advance growth which has arisen prematurely.

The methods of reproduction outlined for mixed hardwood stands and for pure chestnut should be applied whether the two types occur on distinct areas of considerable extent, or, as is quite common, in small groups. In a woodlot of any size, groups of chestnut are apt to be distributed among mixed groups of oak and other hardwoods. These groups of chestnut, even if composed only of the trees on two or three stools, should be reproduced by clear cutting, while the small areas covered with mixed hardwoods are handled in a series of reproduction cuttings. Thus a combination of the seed method with the simple coppice system is applied to the same body of timber.

The percentage of the volume taken out by the reproduction cuttings in mixed hardwood stands will vary greatly. In the first cutting, influenced by the condition of the seedbed and by the amount of advance growth on the ground, the percentage cut in stands previously thinned may run from as low as 15 to over 50. The succeeding cuttings before the final one, necessarily remove a much higher percentage than the first; or rarely under 50 per cent. of the total volume.

II. Stands From Early Youth Under Forest Management.

So far in southwestern Connecticut very few stands have from early youth received careful treatment. But perhaps the most comprehensive view of the treatment required by a mixed hardwood stand can be secured by outlining its management from youth onward. This will include a partial repetition of the treatment advised in the case of untreated stands.

The first operation for which there is need in the young stand is a cleaning. A cleaning as distinguished from a thinning has for its object the regulation of the mixture of species in

the stand, and the favoring of seedlings as against sprouts; and being made ordinarily in young growth it usually fails to show a financial profit.

After a woodlot is cut clear a great many undesirable species seed in and compete with the valuable sprout and seedling growth. Such worthless species as grey birch and poplar by their rapid growth may overtop and suppress oak and hickory. Often sprouts are found shading seedlings of the same species. As the latter are wanted in the main stand, it is desirable to cut out the hindering sprouts. Such operations are cleanings. They can theoretically, in the majority of cases, be employed to advantage after the ordinary clear cutting. Of course, where a fully stocked stand of thrifty sprouts or valuable seedlings occupies the ground after cutting, a cleaning is unnecessary. Whether in stands successfully reproduced by successive cuttings, a cleaning will be required cannot be definitely stated. In pure chestnut stands cut clear, cleanings are unnecessary.

The age at which the cleaning should be made will depend on the density of the stocking and the rapidity with which the young trees close together. It should not be made until the crown cover is complete. Between the ages of 10 and 15 years will be the best period. If longer delayed, a cleaning will be too late to accomplish its purpose.

Fifteen sample plots each of from 1/16 to 1/8 acre in size, taken in an 8-year old coppice in which a cleaning had just been made, produced the following figures:

The chief species were chestnut, white, black, red and chestnut oaks, hickory, grey birch, poplar, and soft maple.

Average number of trees per acre before the cleaning, 6,800.

Number of trees removed by the cleaning ranged from 15 to 45% of the total number, average 30%.

No salable wood produced by the cleaning.

Cost of the cleaning, $2.00 to $2.50 per acre.

The cleaning would have been more effective here if delayed a few years, as the canopy had scarcely closed in many places.

While undoubtedly cleanings furnish valuable aid in regulating the mixture, it is extremely questionable whether they are justified on a financial basis, at an expenditure of $2.00 per acre.

By the time the young stand is 20 years old the need of a true thinning will be felt. If no cleaning has been made at an earlier date, this first thinning will aid in regulating the mixture. But in stands of this character (which have lacked a cleaning) many individuals of undesirable species will have gained such positions that they cannot be removed by the thinning without creating large gaps in the forest cover.

No reliable data is yet at hand to show the volume per cent. which can be removed. It will probably fall somewhat below that removed by the preliminary cutting shown in Table 1.

A thinning in 20-year old stands ordinarily will at least pay the expenses.

Following the first thinning at regular intervals of 5 to 10 years, successive thinnings afford the necessary treatment which the stand demands until the time for reproduction arrives.

In pure chestnut stands or wherever sprout reproduction is sought by a clear cutting system, the successive thinnings continue right up until the crop is cut clear.

In stands otherwise handled when the time for reproduction arrives, reproduction cuttings, as have been already described, are initiated.

Unless protection from forest fires can be obtained, management of hardwood lands on a permanent basis should never be attempted. The same is true as regards protection from grazing. Grazing, however, is here a lesser evil and is confined almost wholly to small woodlots adjacent to farms. The control of this evil is in the hands of each individual owner and presents few difficulties. Control of the frequently recurring surface fires presents an altogether different proposition. The damages to the producing power of the soil, and to the crop caused by these fires are too well understood to need elaboration here. Control of forest fires while devolving to a certain extent upon every owner is at the same time in its broadest aspect a matter requiring State effort to be effective. Each owner, however, when putting his forest land under management can take such precautionary steps as will help him to prevent the entrance of fire on his land and to control it should it once get started.

By disposing of the limbs and tops left after thinnings and cuttings, danger of a severe fire can be avoided. If brushy tops

are allowed to remain untouched, they dry out, and, rotting slowly, present for a number of years a serious fire trap. The ordinary surface fire reaching an area covered with these tops increases greatly in violence and becomes very difficult to control. In order to confine the fires to light surface fires which do less damage and can be controlled more easily than hot brush fires, the brush and tops should either be burned after the cutting or lopped into small pieces and scattered over the ground. When tops are cut up so that after being scattered they lie flat on the ground, decay soon starts and the tops almost immediately cease to be inflammable. This method is perhaps the best in dry weather, when it would be dangerous to burn the brush.

When the cutting goes on in the winter time or in wet weather, the tops and limbs can be thrown by the choppers directly onto fires and burned. By choosing small openings for the fires, the standing trees escape injury.

The cost of disposing of the logging debris is low. When the workmen become familiar with the operation, burning the brush can often be included in the cutting price without greatly increasing the latter. One case near New Haven can be cited where burning brush has been carried on for five years. At first somewhat higher, the contract price per cord for cutting and piling wood cut out in thinnings has been reduced to $1.00 to $1.10, which includes the burning of the brush. Lopping of the tops instead of brush burning could be contracted for at the same price. Where the brush is disposed of in a separate operation about ten cents per cord of wood cut should be allowed.

The maintenance of fire lines is often urged as the best method of protecting woodlands. But whether in the particular type of forest and region under consideration the expense of constructing and maintaining fire lines is justified by the results secured is debatable. A large percentage of the wooded area lies in comparatively small blocks interspersed by farmland. No fire lines are here required. In other places where continuous forest spreads over considerable areas the woodland is broken into sections by the country roads, and further subdivided by the numerous woods roads. These roads in case of need can act as lines for fighting fire and for back firing, even if not kept as fire lines constantly bare of litter. Only occasionally do big tracts of a

thousand or more acres occur untraversed by country roads and even such tracts ordinarily have woods roads.

Instead of spending money annually for the construction and maintenance of fire lines, it is believed that the small owner can better protect his hardwood stands by personal work among his friends and neighbors, looking toward the establishment of a better sentiment regarding the setting and fighting of forest fires. The names of towns could be given which, formerly overrun by frequent surface fires, in the last few years as a result of a better understanding among the inhabitants of the damage done by fires, now are nearly immune.

By inculcating the spirit of carefulness in setting fires and of willingness to fight them when started, the private owner can accomplish more toward protection than by constructing fire lines.

What has been said regarding fire lines should not be taken as applying to other regions however near, or to other types of forest. Fire lines properly arranged and cared for undoubtedly further excellent protection, but in this particular case their maintenance appears unwarranted.

RALPH C. HAWLEY.

THE FORESTS OF ARKANSAS.

The State of Arkansas covers an area of 52,000 square miles. Originally this entire area was clothed with forests with the exception of about 900 square miles of prairie land located mostly in Prairie and Arkansas counties. Fully 80 per cent. of the State remains in woodland, of which two-thirds is commercial forest. This places Arkansas in the foremost rank of the timbered States and makes it the center of unusual activity in the lumber industry. The delay in opening up these vast forests is more than compensated by the present vigor of exploitation.

Geographically, the State is divisible, roughly, into upland and lowland. The lowland, comprising three-fifths of the area, occupies the east and south portions of the State. Along the Mississippi River it lies in a low, level strip 50 to 100 miles wide. South of the Arkansas River and west of these flood plains is a gradually undulating region which ascends northward to the Ozark Mountains. The upland occupies the entire northwest portion of the State.

Conforming to these general topographic divisions we recognize three forest regions. They are (1) alluvial bottoms; (2) rolling lowlands; (3) Ozark Mountains. Within each are several types, usually difficult to define because of the gradual transition of one into another. The State's location, diversity of topography and soil, together with a moderate, humid climate, are especially favorable to the occurrence of a rich and valuable flora. There are fully 60 tree species of commercial importance growing within its bounds.

1. The alluvial bottoms are the flood plains along the Mississippi, Arkansas and Red Rivers and their tributaries. The land is low and flat, covered with dense forests interspersed with lakes and marshes, and submerged frequently by the river floods. Practically every river and bayou running through this region is characterized by a rather narrow strip of bottom land adjacent to either bank, becoming narrower as one leaves the main region. There are occasional low ridges lying parallel to the Missis-

sippi. The most important one is known as Crowley's Ridge and lies between White and St. Francis Rivers.

The soil of the bottoms is deep and rich. It is made up of layers of sand, loam and clay which have been deposited by the rivers during flood time. The fallen leaves and twigs do not have a chance to accumulate on the surface but are covered over by the alluvial deposits. Were it not for the frequent inundations such soil would be exceptionally valuable for agriculture, as are the drier ridges along the river banks.

Three types are distinguishable, *viz: Ridge, glade* and *slough.* The *ridges* are long, low, meandering elevations above water level during the overflow season. The species of merchantable importance most commonly found on these situations are red gum, 40 per cent.; cow and white oak, 30 per cent.; white and green ash, 10 per cent.; cottonwood, 5 per cent.; together with sycamore, mulberry, white elm, persimmon and hackberry. Associated with them are many inferior species, such as red and silver maple, boxelder, slippery elm, dogwood, honey locust and pawpaw.

The *glades* occur between the ridges just described, being frequently interrupted by cross ridges. During floods water backs up from the sloughs and stands for several months, often being withdrawn by evaporation or through percolation. The characteristic species are red and black gum; cow, willow, swamp white and red oak; hackberry, pecan hickory, red maple, white elm, river birch, willow, cottonwood and cypress. There is usually a dense undergrowth of sedge, elbow-bush, poison ivy, wild grape, cane and coarse wiry grass.

The *sloughs* are covered with water most of the year. Cypress and tupelo gum are the only species occurring in this type, which is relatively least important. It is more prevalent in the immediate proximity to shallow rivers and their tributaries than farther back where only the ridges and glades are found. Reproduction is usually lacking.

The alluvial bottoms afford special inducements for conservative management. Most of the land is not naturally cultivable and much of it cannot be reclaimed with reasonable expense. Tree growth is very rapid and reproduction is readily secured.

Most important of all, the danger from fire and wind is extremely small, making expensive protective measures unnecessary.

Best results can be secured by clear cutting in strips not exceeding 600 feet in width and at right angles to the prevailing winds, leaving strips of standing trees of the same width. All of the inferior species should be removed or destroyed. Logging with steam skidders is recommended. They can be placed along a railroad at the end of each strip to haul in the logs for a distance of one-half a mile or more on each side of track. In this way little swamping is required, heavy hauling by teams is unnecessary and the ground is put in good condition for seeding. Its advantages over the selection system are that logging is made easier and cheaper, marking of trees is obviated, and better natural reproduction of the desirable species is secured. The reserve strips should be cut over as soon as the young growth on the intervening strips begins to bear seed, which will be in about 20 or 25 years. By this method the second cutting will equal the first, and subsequent crops are assured.

2. The rolling lowlands comprise about one-fifth of the State's area. The soil varies from deep, stiff sandy loam in the flats to gravelly clay on the ridges. It is poorly adapted to agriculture unless heavily fertilized. Tree growth is usually rapid and in most instances will afford better returns than farm crops. The forest may be divided into three general types. They are *ridge, flat* and *creek bottom.*

The *ridges* are usually well-drained and occupied mostly by shortleaf pine. In many places it is the only species, but the hardwoods encroach where the soil conditions become more favorable. The principal species are Spanish and post oak, rarely above medium size. Wax myrtle and huckleberry form the principal underbrush.

The *flats* are largely covered with loblolly pine associated with hardwood growth peculiar to moist soil. The prevailing species are red and black gum, white, Spanish, post and willow oak, hickory, red maple and holly. The ground cover varies from weeds and grass to dense thickets of wax myrtle, brambles, sumac and hardwood sprouts. Loblolly pine will grow on the uplands and also in the creek bottoms, but the shortleaf is confined to the better drained soils.

The *creek bottoms* are similar to the Mississippi bottoms in character of tree growth. The principal species are gums, willow oak, red maple, cypress and loblolly pine. It is here that the loblolly attains its largest dimensions but it occurs only as scattered individuals among the hardwoods.

The stand of timber on the rolling lowlands will vary from 5,000 to 15,000 feet per acre, with a probable average of 7,000 feet. Growth of the pines is quite rapid where they have sufficient room, and reproduction is usually excellent in all openings and abandoned fields. The wood of the two species cannot be readily distinguished, and since loblolly pine grows faster than shortleaf, it is to be preferred. From 40 to 60 years is required for a tree to attain merchantable dimensions. Nearly all of the timber now cut is over 100 years of age. The selection system of cutting is applicable to this region, the proper diameter limit varying from 12 to 16 inches at breastheight.

Windfall is common, especially on the flats, and much damage is also caused by insect attacks. But by far the greatest danger is from fire and all successful plans for continued lumbering in this region must provide adequate protection. Probably the best system is to burn the slash at a time when the least damage will result to the young growth and standing trees. From that time until the seedlings have reached a height of six feet all fires must be rigorously excluded. This can be done by patrolling the lands during the danger season and burning out fire lines 200 feet wide to connect with roads and streams. When the pines are six feet high the tract should be carefully burned over at a favorable time in order to lessen the danger of a more serious conflagration later. In this way lands may be adequately protected at annual cost of about 4 cents per acre.

The price of pine stumpage has risen enormously within late years. Fifteen years ago it was possible to buy timbered land for from $1.25 to $2.50 per acre, or from 10 to 30 cents per thousand feet for the timber alone. At present such timber is worth from $2.00 to $4.00 per thousand. The next five years will probably witness a continued increase.

3. The Ozark region occupies the northwest portion of the State and comprises about two-fifths of the entire area. North of the Arkansas River are hills and irregular, poorly-defined

mountains, reaching their culmination in the Boston range. South of the river the ridges are steep and well-defined. They attain their greatest altitudes in Mounts Magazine and Fourche, whose peaks rise 2,800 feet above sea level.

The soil of this region is mostly rocky, shallow and sterile. There is great variation in the composition and quality of the forests, due to differences in elevation, and conditions of soil and moisture. Three common types are distinguishable, *viz: ridge, slope* and *river bottom.*

The *ridge* type occupies the crests of the ridges and some of the poorest knolls and foothills. The soil is very poor and stony, and subjected to the action of severe winds. The trees are small, short and scrubby. The prevailing species are blackjack oak, red oak, black locust, chinquapin-chestnut, wing-elm, and hickory. The open undergrowth consists of huckleberry and briars.

The *slopes* are usually well wooded, the timber being best near the base of the hills and gradually entering the ridge type. The forests of the north slopes are better than on the south, due to difference in the moisture conditions. South of the Arkansas River shortleaf pine is a very important tree and is especially abundant on the south slopes, though usually in open stand. It is of fair quality but of smaller dimensions and closer grain than that grown on the rolling lowlands. It makes its best development in the gulches and on the lower slopes. Trees in mixture are red, white and post oaks, chinquapin chestnut, black locust and cherry. White oak is the principal tree on the north slopes. North of the Arkansas River the shortleaf pine occurs sparingly. The most important trees are the oaks, gums and black walnut, though most of the walnut has been removed.

The *river bottoms* are usually narrow and much of the ground has been cleared for farming. The prevailing species are sycamore, black and red gum, white, red, willow and burr oak, black walnut, basswood, holly, red maple, beech, elm and hickory. The forest is usually dense and with much underbrush. Trees reach their largest dimensions in such situations.

The forests of the Ozark region are being seriously injured by fire. The reproduction of pine is largely prevented and an undesirable growth of inferior hardwood sprouts results. Proper

management of these forests will include fire protection, removal of inferior species and cutting by the selection system.

The State of Arkansas as a whole is not well adapted to agriculture. Most of its area is absolute forest land and if properly managed will become a prime factor in the future prosperity of the State. If present methods are continued, most of this land will become barren and unproductive. The total amount of standing timber in the State is approximately 100,000,000,000 feet, of which pine comprises one-fifth. The total cut for the year 1906 was nearly 2,000,000,000 feet, the largest in the history of the State. At this rate 50 years will be required to cut off all of the timber, assuming that the factor of growth will be offset by deterioration and waste. In all probability the rate of cutting will increase so materially that the available timber supply will be largely exhausted within 20 years. Most of the Pine mills will cut out within 10 years, while the cypress industry is rapidly nearing an end.

The time is certainly opportune to begin active work in forestry instead of waiting as so many other States have done until the forests have been destroyed. So far the policy has been wholly destructive, and little thought has been given to the perpetuation of so valuable a resource. The National Government has lent assistance by withdrawing from public entry nearly a million acres of vacant land in the Ozark region as a proposed national forest. It marks a good beginning, but since most of the lands are private property it remains for the State to demonstrate to the owners the practicability of forestry and to direct and encourage their efforts.

SAMUEL J. RECORD.

CURRENT LITERATURE.

HENRY S. GRAVES, *in Charge.*

Economic Forestière. Tome III. By G. Huffel. Paris 1907. 512 pp. Price, 10 fr.

The third volume, completing the great work of Professor Huffel, forms a worthy part of the whole series of studies. It is composed, like the other volumes, not as a systematic textbook, but as independent studies which permit diversions, and disproportions of matter which would be welcome but not permissible in a more methodical textbook. The principal subject of this volume is Forest Management or Forest Regulation. As in former volumes the historical element plays a considerable role, and, indeed, a whole study of nearly 200 pages is devoted to the history of the subject in France. This historical treatment is in our days most useful as well as entertaining and forms the attractive feature of the treatment. Certainly the usage in France and its historical development are clearly and interestingly brought out.

Such a work deserves a longer critical review, but limitation of space forbids at this time to bring more than this mere notice, which hardly does justice to the value and importance of the work.

B. E. F.

Western Australian Timber Tests, 1906. The Physical Characteristics of the Hardwoods of Western Australia. By G. A. Julius. Perth, 1906. 36 pp. 72 plates.

These tests, some 16,000 in number, the first of their kind on Australian timbers, were undertaken in the Railway Department of the Government. They were executed according to the methods devised by the former U. S. Division of Forestry (so acknowledged), which set the standard everywhere for this kind of testing. The results develop the superior quality of Australian hardwoods, of which 21 species and varieties were tested, most of them belonging to the Eucalyptus. The tabulated results are also exhibited in curves and a long series of photographic repro-

ductions of typical breakages are given, as well as descriptions and illustrations of the apparatus of most modern character, the whole publication being of the first order.

The following interesting general deductions are made:

(1). Timbers in which the grain is closely twisted and interwoven are in general very hard, dense and heavy; high in compressive strength both edgewise and crosswise, and also in shearing strength along the grain; comparatively low in moisture relatively to the straight-grained timbers, they are low in tensile strength, and therefore to a certain extent less strong where used as "beams." Such timbers are Wandoo, Tuart, and York Gum.

(2). Timbers in which the fibres are straight and even, are relatively less hard and dense, and are lighter; considerably higher in moisture percentage when green; stronger in "tension," and therefore generally stronger as beams, but correspondingly lower in compressive strength and in shearing strength along the grain. Such timbers are Karri, Red Gum, Blackbutt, and Jarrah.

(3). Timbers lying midway between these two conditions, although not so "dense" and "hard" as those coming under the first heading, are in general stronger than either; such timbers being Yate, Salmon Gum, and Morrell.

(4). Timbers coming under the first and third headings in general are to be found either in districts where the rainfall is comparatively light (such timbers being Wandoo, York Gum, Salmon Gum, and Morrell) or in localities where the soil is porous and does not retain the moisture, such as the sandy country to which Tuart is almost wholly confined.

The straight-grained timbers are to be found in districts with a heavier rainfall, and particularly in soils that hold the water.

(5). In every case, in the timber grown in the dry districts—viz: Wandoo, York Gum, Salmon Gum, and Morrell—the moisture percentage is very low, the average of the four, when green, being 28 per cent., and the sap is of a thick viscous nature. These timbers, when cut, season very slowly, and shrink to a comparatively small extent in seasoning.

In timbers growing in loose "porous" country, such as Tuart and Yate, the moisture percentage is higher, averaging 37 per cent., and the sap is of a more fluid nature.

These "season" more rapidly, but shrink very little in the process, this being markedly the case with Tuart.

In the straight-grained timbers—Karri, Jarrah, Red Gum, and Blackbutt—the moisture percentage when green averages 60 per cent., the sap being very fluid; and these timbers season more rapidly and shrink to a greater extent than those with lower initial moisture.

The strongest timber, probably the strongest in the world, and far ahead of all others, is one as yet practically unknown, Yate *(Eucalyptus cornata)* which developed a breaking load of 35,000 pounds, five times the usual specifications for wrought iron. The average figures for it are 24,200 for tension, 21,500 for cross-bending, 11,600 for end compression, 3,200 for shearing, with a green weight of 79 pounds per cubic foot. Salmon Gum *(Eucalyptus salmonophloia)* and Ironbark *(E. Sideroxylon)* from New South Wales are close neighbors to this strongest wood. It is a tree growing to 2½ or 3 feet in diameter and 100 feet in height, common in the southwest portion of the State.

The relations of density, weight, moisture and strength, so fully brought out by the tests of the U. S. Division of Forestry, were fully corroborated in these tests, except for tensile strength (unreliable tests!).

The remarkable durability, particularly of Jarrah and Wandoo, was demonstrated on sleepers, for over 19 years in service (with a 20-inch rainfall in four months, the remainder of the year being very hot and dry). Some Jarrah piles were found sound after 72 years, "*although* completely saturated with saltwater," the author says instead of "*because.*" These were not even attacked by Teredo. Holding power of spikes were also tested.

If there were more likelihood of importing these timbers, it would pay our railroad companies to study these reports. As it is, at least those engaged in testwork will find suggestive reading in this volume.

B. E. F.

Handbuch der Kaufmännischen Holzverwertung und des Holzhandels. Von Leopold Hufnagl. Second edition. Berlin, 1907. 340 pp. Price, mk. 8.

Although naturally written for the conditions prevailing in

Europe, this treatise on wood markets and wood trade, perhaps the first and only one of its kind (possibly with exception of the following one), contains much of general interest both for the student of political and industrial economy and for the practitioner. Certainly the conditions and methods of wood trade in the various European states are nowhere so fully discussed.

The book is divided into five chapters. The first treats of the methods and usages of wood sales and wood trade in general, including measurements of wood, tariffs, statistics and calculations as regards choice of sortiments, mill enterprises, etc. The second chapter discusses the various sortiments of wood and their most advantageous preparation and use in various industries; the third treats in detail of saw-milling; the fourth discusses the trade according to species and their best use; the fifth deals with methods of transportation. The financial side is everywhere made prominent, and in the suggestions regarding calculations for the most advantageous utilization of the wood-crop lies the main feature of the book.

Even if much of the business methods described is of no direct value to us, there is always something suggestive in what others are doing, and, as we are just in the period of changing methods toward a more thorough and rational utilization those in actual commercial forest management will benefit from the perusal of this thoroughly practical, yet scientifically sound volume.

B. E. F.

Holzproduktion, Holzverkehr und Holzhandels-gebraüche in Deutschland. By Eugen Laris. 1907. 349 pp. Price, k. 7.20.

This book, of somewhat similar import as the preceding, confines itself to the description of usages, written and unwritten, in the German wood market, and has less general, although probably considerable local value.

Ueber Düngung im forstlichen Betriebe. By Dr. M. Helbig. Neudamm, 1906. Price 3 mk.

Contains in convenient form, critically viewed, all that is known about the use of fertilizers in forest growing, with a full list of the literature. It contains also a discussion on the nutri-

tive elements of the soil, tabular statements of the requirements of various crops and other material in the same line.

The financial results receive full consideration without optimistic tendencies. When an expenditure of 48 mark per hectar for a lime dressing was found in the fourth year to have lost all influence, the profitableness of the use of fertilizers, except in rare cases, becomes questionable.

Mitteilungen aus der Kaiserlichen Biologischen Anstalt für Land—und Forstwirtschaft. Heft 1 und 2. Springer, Berlin, 1906.

The Biological Institute for Agriculture and Forestry, which formerly was a branch of the Imperial Health Department and became independent in 1905, has begun to issue, besides its leaflets, non-periodical Mitteilungen. Among the forestry subjects investigated the rust on *Pinus Strobus,* and the aphids on *Abies* are found.

The Use Book. Regulations and Instructions for the use of the National Forests. U. S. Forest Service, Washington, July 1, 1907. 248 pp. A revised and enlarged edition of the Use Book, containing the latest rules for the use of the National Forests.

The Use of the National Forests. U. S. Forest Service, Washington, D. C., 1907. 42 pp.

This publication is apparently designed as a primer to show the policy of the Forest Service on the National Forests. It is published in attractive form as a booklet, bound in cloth, and profusely illustrated with excellent photographs. It is written in very simple and clear style, and explains in a popular way what the purposes of the National Forests are, and how they benefit the public. This publication should go a long way toward allaying the suspicions of the western people, and in popularizing the work of the Forest Service. It is understood that the book was written by Mr. F. E. Olmsted, District Inspector, National Forests, although his name does not appear on the title page.

The Longleaf Pine in Virgin Forest. A Silvical Study. G. Frederick Schwarz, New York, 1907, 135 pp.

As explained in the title, this book presents a study of the life history of Longleaf Pine as it occurs in the virgin forest. It is the result of original observations made in the Gulf States from western Florida to western Louisiana. The study was, therefore, general in character, as distinguished from the detailed investigations which must be made in different restricted localities before our knowledge of the tree will be adequate.

Mr. Schwarz discusses the distribution of the Longleaf Pine, the character of the forests, the evolution of the forest, the silvical characteristics of the tree including tolerance, demands on soil, relation to fire, disease, wind, and other injurious influences, the growth of the trees, and finally the management of the forest from the standpoint of forestry.

Mr. Schwarz describes the forest as by far the greater part purely longleaf growth. He states that while there are groves of middle aged and young trees in small patches, the bulk of the forest is composed of trees that have passed the early and more vigorous stages of growth. He calls attention to the uniform character of the forest, growing, as it does, largely in even-aged groups. This is the result in part of the reproduction of the tree, but is due also to the fact that it is a very intolerant species.

The author gives many interesting facts regarding the effect of fires on Longleaf Pine. His conclusions are as follows:

"1. They undoubtedly destroy a considerable number of seeds, occurring as they do at all seasons and being particularly severe in the fall of the year.

"2. While seedlings offer a remarkable resistance to injury from fires, those under two years of age rarely escape. Even among older seedlings a certain proportion is killed where fires occur at frequent intervals.

"3. The injuries to the bark and buds of saplings and young trees sometimes lead to unsoundness as the trees grow older. In mature trees recurring fires may gradually burn into the lower parts of the trunk, lessening its value and so weakening the tree as to expose it to the danger of being thrown by the wind.

"4. The constant repetition of surface fires greatly impoverishes both the seed-bed and the soil. The mold, which not only

furnishes nutrition but also protects and improves the condition of the soil, is thereby destroyed, and the germination of seeds as well as the growth of trees at all ages is unfavorably affected."

The chapter on rate of growth is based on only a small number of tree analyses which are given as illustrations rather than as data from which to draw definite conclusions.

The chapter on forest management is of special interest as showing the principles upon which a system of silviculture must be based. It is of course impossible to lay down any definite rules of treatment because the study is of a general character.

The book is well illustrated with attractive photographs. The style of writing is simple and direct, and while distinctly technical in character, the book is exceedingly readable.

The Forest Service: What It Is and How It Deals with Forest Problems. Circular No. 36 (3rd edition), U. S. Forest Service, Washington, D. C., 1907, 38 pp.

This circular is of exceptional interest as it explains the new organization of the Forest Service. On account of the new duties of the Service in connection with the administration of the national forests, it has been necessary to make changes from time to time to meet new conditions. Apparently the organization is now on a very permanent basis and it is acknowledged to be as efficient as any department in the Government. The new organization is much simpler than formerly, in spite of the multiplication of new duties. Under the new plan there are four branches and fourteen offices. The branches are called Grazing, Operation, Silviculture, and Products, and each is directly responsible to the office of the Forester. The Forester has immediate charge, in his own office, of law, information, dendrology and inspection. The branch of Grazing is charged with all matters connected with grazing within the national forests: compared to the other branches, this is small, but if the Forest Service should be placed in charge of grazing outside of the national forests this branch would be able to handle the work. The branch of Operation has charge of all matters connected with the business of administering the national forest: technical matters, however, are assigned to the branch of Silviculture. This branch has three offices, Extension, Silvics and Management, which

conduct all technical work, not only on the national forests, but that connected with co-operation with States and private owners. Under the branch of Products are the offices of Wood Utilization, Wood Preservation and Publication. Apparently the last office was placed under Products for convenience and in order not to overburden the other branches.

The Service is to be congratulated on its new organization.

Annual Report of the State Forester of Connecticut, 1906. Part VI. Report of the Connecticut Agricultural Experiment Station.

The report shows very satisfactory progress. Considering the very small appropriation which the State of Connecticut gives to forestry, Mr. Hawes is to be congratulated on the results of his work. The report describes the experimental work at the State plantations on the State forest, and the assistance to private owners. A small working plan is shown to illustrate the assistance which the forester gives to the private owner who takes advantage of offered co-operation. The report shows that private owners planted during the year nearly 100,000 plants of pine, chestnut, oak and other trees. The work of the State Forester in organizing a fire service has been admirable. By an expenditure of $500 the fires have been kept down to relatively few, only 88 being reported for the year. This undoubtedly does not cover all the fires, but shows a large decrease over preceding years. It is believed by the State Forester that by this system the damage has been reduced from $120,000—$160,000 to $30,000—$40,000. It is a pity that the State of Connecticut does not make more liberal appropriations for this valuable work.

Year Book of the Department of Agriculture, 1906. Contains the following articles on forestry: National Forests and the Lumber Supply. By Thomas H. Sherrard; Forestry Associations (table); Schools of Forestry (table); Progress of Forestry in 1906.

Production of Red Cedar for Pencil Wood. Circular No. 102, U. S. Forest Service, Washington, D. C., 1907, 19 pp. By L. L. White, Forest Assistant.

An uncommonly interesting study of an important species The author has taken up the subject of management and shown

how Red Cedar may be profitably raised. His conclusions are as follows: "1. In order to have a constant supply of cedar on a sixty-year rotation, it would be necessary to have approximately 225,000 acres fully stocked. 2. The present ownership of cedar lands is entirely unsatisfactory in supplying the demand for cedar. 3. Existing methods of cutting all classes of second-growth cedar for posts, etc., are unprofitable and wasteful. It should be preserved wherever quality and quantity are suitable for pencil wood or other more valuable products. 4. As a means of perpetuating a constant future supply on a paying basis, it is suggested that companies interested in this wood purchase large holdings of suitable cedar land and manage the tract for cedar production on a basis of sustained annual yield. Cedar can be grown at a very fair profit for lead pencils."

Seasoning of Telephone and Telegraph Poles. Circular No. 103, U. S. Forest Service, Washington, D. C., 1907. 16 pp. By Henry Grinnell, Forest Inspector.

Brush and Tank Pole Treatments. By Carl G. Crawford. Circular No. 104, U. S. Forest Service, Washington, D. C., 1907, 24 pp.

Suggestions for Forest Planting in the Northeastern and Lake States. Circular No. 100, U. S. Forest Service, Washington, D. C., 1907. 15 pp.

The Open-Tank Method for the Treatment of Timber. By Carl G. Crawford. Circular No. 101, U. S. Forest Service, Washington, D. C., 1907. 15 pp.

Suggestions for Forest Planting on the Semi-Arid Plains. Circular No. 99, U. S. Forest Service, Washington, D. C., 1907. 15 pp.

White Oak in the Southern Appalachians. By W. B. Greeley and W. W. Ashe. Circular No. 105, U. S. Forest Service, Washington, D. C., 1907.

Location, Date of Latest Proclamation, and Area of the National Forests in the United States, Alaska, and Porto Rico. Circular, U. S. Forest Service, Washington, D. C., July 1, 1907. 4 pp.

This circular shows that there are now a total of 156 National Forests in the United States, covering an area of 145,855,835 acres. There are in addition 2 reserves in Alaska of 4,909,880 acres, and one in Porto Rico of 65,950 acres.

Further Studies on the Properties of Unproductive Soils. By Burton Edward Livingston. Bulletin No. 36, U. S. Bureau of Soils, Washington, D. C., 1907. 71 pp.

Studies on the Movement of Soil Moisture. By Edgar Buckingham. Bulletin No. 38, U. S. Bureau of Soils, Washington, D. C., 1907. 61 pp.

Effects of Shading on Soil Conditions. By. J. B. Stewart. Bulletin No. 39, U. S. Bureau of Soils, Washington, D. C., 1907. 19 pp.

Some Factors Influencing Soil Fertility. By Oswald Schreiner and Howard S. Reed. Bulletin No. 40, U. S. Bureau of Soils, Washington, D. C., 1907. 40 pp.

Report of the Superintendent of Forestry. Part IX, Annual Report, 1906, Department of the Interior, Dominion of Canada. 32 pp. Ottawa, Canada, 1907.

Brief Instructions to Massachusetts Fire Wardens. By F. W. Rane, State Forester, Boston, Mass. Pamphlet, 11 pp.

Third Annual Report of the Shade Tree Commission of the City of Newark, New Jersey. 1906. 27 pp.

Production of Lumber, Lath, and Shingles, by States and Species, 1906, 1905, and 1904. Chart, U. S. Forest Service and Bureau of the Census, Washington, D. C., 1907.

PERIODICAL LITERATURE.

In Charge:

Botanical Journals, ... R. T. Fisher
Foreign Journals, ... B. E. Fernow, R. Zon, F. Dunlap
Propagandist Journals, ... H. P. Baker
Trade Journals, ... F. Roth and J. F. Kummel

FOREST BOTANY AND ZOOLOGY.

Spruce Migration in Sweden.

Interesting studies are made by the Swedish Experiment Station on the history of distribution of species. According to Hesselmann and Schotte the spruce (Norway) did not enter Sweden from the South as most other tree species, but from the East through Finland, and did not arrive before pine and oak and other deciduous trees had formed extensive forests. For this assumption the fact is cited that the fossil remains found in bogs become fewer and fewer southwards and reach their most southerly finds at Jönköping. Moreover a definite southwest limit of the spruce is demonstrable at present, with a zone in front where this species is sparsely distributed.

The spruce is a very aggressive species and capable of entering most plant and forest formations, gradually changing them to spruce forest. In pine woods the spruce finds satisfactory seeding conditions, grows rapidly in the light shade, then interferes with pine regeneration and the mixed forest soon becomes pure spruce, if not interfered with by man.

The unregulated selection method has fostered this change, the pine finding too little light in the openings. In birch and oak forests the same favorable conditions for the spruce exist, only the beech on account of its tolerance can wage war with the spruce, and these two species can replace each other according to soil and other conditions, the one more readily than the other.

On the mossy heaths the spruce takes rapidly possession of the ground, but on the pure heaths and the lichenous heaths it does

not thrive, especially as these latter are frequently burnt over for the grass.

From good historic evidence it appears that 200 years ago in the district of Nord Skäne the spruce was very limited, but during that time has conquered a large territory, the early seeding, when 25 to 30-year old, contributing to its progress. The present southern boundary, then, is a historical limit and does not determine the possibility of extension, to which neither soil nor climate offer impediments.

Die Fichte an ihrer Südgrenze in Schweden. Meddelander frâ Statens Skogsförso ksanstalt. Heft 3. 1907.

Growth in Virgin Woods.

The Hungarian Central Forest Experiment Station publishes a journal containing reports of its work which has special interest because dealing largely with conditions in virgin woods. Bartha reports on growth conditions of the Norway Spruce in virgin growth, especially relation of height and diameters measured at 1/16, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$ of total height. On the basis of his measurements he formulates certain propositions: The size of the root collar he finds in direct relation to age and the surest means for determining the age. Tree heights incline—without reference to age, diameter. tapering or root form—to maxima rather than minima. Between tapering on one hand and age, height and diameter on the other no direct relation is recognizable. The largest portion of the volume—80%—lies below the middle of height, only 3% on the last quarter of tree height.

For the calculations the author used a number of different formulæ, and found Schiffel's (see QUARTERLY, Vol. II, p. 262) the best, but somewhat complicated; for general use he recommends Huber's method.

In virgin beech stands of Hungary, in which man has had no hand, Fekete finds the following proportions between diameter and height. His procedure in using the measurements is to place all the calipered trees in sequence by diameters, then by dividing their number by 100 he determines the number of trees to be counted in one diameter class, for instance if 300 are measured,

3 go to each class. The middle stem of these he takes as the typical stem of the class.

Diameter class	D. B. H.	Total height
c	*cm*	*m*
10	5.3	5.5
20	7.4	7.8
30	9.9	10.7
40	12.8	13.8
50	16.4	17.1
60	20.8	20.2
70	26.2	23.1
80	32.5	25.8
90	40.	28.2
100	50.5	30.5
	82.4	34.5

From Erdészeti Kisérletek. Centralblatt f. d. g. Forstwesen, May, 1907. pp. 212-215.

A New Spruce. A description of a new Spruce from the Canadian Rockies has just been published by Mr. Stewardson Brown. "The species," he says, "has been referred by authors to both *Picea Canadensis* (Mill.) B. S. P., and *P. Mariana* (Mill.) B. S. P., to both of which it bears a certain resemblance, but from two months' experience with the tree during the past season, in the region from Banff, Alberta, to Field, B. C., I am satisfied that it is distinct from either. * * *" Mr. Brown describes the new species under the name *Picea Albertiana.*

A new Spruce from the Canadian Rocky Mountains. Torreya, June 1907.

Bark of Fir. Among various teratological abnormalities in tree growth which Badoux records in the *Journal forestier suisse,* mention is made of a fir with thick, deeply fissured, rough, brown bark for 18 feet of its height, the tree being otherwise thrifty and normal, 9-inch in diameter, standing among its companions with their characteristic smooth white bark. According to the description it must resemble our *Abies nobilis.* The author proposes to call it *Abies pectinata corticata,* although so far only one specimen is known. Another freak are three warty firs, with rings of pyramidal, inch high ex-

crescences or warts on the bark, which are not occasioned, as might be suspected by branch growth.

Abnorme Rindenbildung der Tanne. Schweizerische Zeitschrift für Forstwesen. July 1907. p 219.

Competition of Trees.

Dr. Roland Harper depicts two oaks from the campus of the University of Alabama, showing that *Quercus Phellos* (the deciduous species) has prevented *Quercus laurifolia* (the evergreen species) from developing half its branches, crowding it out. The same competition is observed in other cases. In explanation Dr. Harper says: "From the standpoint of succession of vegetation the two species are far apart, *Q. laurifolia* being a sort of pioneer tree, almost confined to the sandy hammocks of the coastal plain from Virginia to Louisiana, while *Q. Phellos* is a tree of the climax forest, more common in the fertile valleys and alluvial bottoms of the palaeozoic region. In temperate Eastern North America all climax species are shade-loving while the reverse is true of many if not most pioneer plants. So it seems likely that when the branches of the two trees tended to interlace those of *Q. laurifolia* failed to develop for lack of sufficient light."

Phaenology and Insect Control.

Dr. Hopkins, observing that certain linden trees in Washington budded a whole fortnight earlier this abnormally warm spring, than others, he supposes them to be early varieties [overlooking the fact that soil conditions do, and may have in this case been the effective agents.—Rev.] Phaenological data collected during the past ten years show quite conclusively that the average time of the beginning of seasonal activity of certain species and varieties may be utilized as an index to the dates each season when at different altitudes and latitudes the conditions are most favorable for action against certain insect pests and plant diseases.

Hopkins makes the normal variation in a given phenological phenomenon about four days for a difference of 400 feet altitude, or one degree latitude. The practical application of the principle here outlined is to be found in Bulletin 58, Bureau of Entomology, U. S. Department of Agriculture.

Science, May, 1907, p. 862.

Relations of Weather to Increment.

A number of articles on this broad subject have appeared in the later issues of magazines, several of which we brief here. The drouth year of 1904, results of which are recorded further on, probably gave the incentive to this active inquiry.

Dr. Cieslar brings a more general, exhaustive article as a result of investigations at the Austrian Experiment Station. The first part is devoted to a discussion of the relation of weather to height growth, the second of the relation to diameter growth. The first relation has apparently never been investigated except by Hesselmann of the Swedish Station, on the pine during the years 1900 to 1903, the year 1901 being hot and dry, that of 1902 cold and wet.

It is to be kept in mind that the buds formed in one period of vegetation have all the embryonic elements of the shoots of the next season, therefore for the number of short shoots or needle bundles in the pine the preceding season is of import. Kuster found the same for *Abies* and for broad leaved trees. Since during the first season also reserve materials are accumulated, Hesselmann argues that the weather conditions of that season also influence the length of the next season's shoots. This surmise was borne out by the actual observations, namely so that the shoots of 1902, the cold year, were unusually long, 50 to sometimes 100 per cent. longer than those of the preceding year, the warm dry summer of that year having, according to Hesselmann, produced this result. In 1903, with a favorable summer, the shoots were unusually short, sometimes consisting only of terminal needle bundles, evidently showing the influence of unfavorable conditions of the preceding season. Plant physiology confirms this causation. We know that the products of assimilation are not all used at once, but partly stored, to be used the next spring in developing the buds. According to Lutz normal young pines show a minimum of reserve materials by July; then an increase of the materials is noted until September. In the young trees observed their use for flowering and fruiting, as Hartig intimates, is excluded. A small storage, therefore, influences the next year's performance.

In Middle Europe in 1904 the months July and August were

excessively hot and very dry, as is shown by comparative tables. As a result only the length of shoots in 1905 was reduced, as the following averages of three 6 to 9-year-old plantations of spruce show, the length of shoots being in centimetres:

	1902	1903	1904	1905	1906
I	11.9	13.3	13.	7.5	17.5
II	14.2	17.5	20.	16.7	24.9
III	6.7	10.4	8.4	4.9	12.8

The height growth of the drouth year suffered only slightly in the first, not at all in the second, but in the drier soil of the last very appreciably. *Weather conditions, which in Sweden according to Hesselmann effected increased height growth in the following year had the opposite effect in Middle Europe.* It is therefore apparent that an abnormal condition of weather may in one climatic zone be advantageous, in another disadvantageous. As demonstrated by Wollny the vegetative activity of plants is governed by that factor of growth which is present in smallest or insufficient amount or else near the maximum in intensity. Fresh soils can produce higher yields only when satisfactory temperature conditions prevail; when all factors of production are at their optimum the maximum of production is reached, when the relation of moisture to temperature, or as the author calls it, the *vegetation quotient*, $\frac{M}{T}$, (by the reviewer long ago, with more directness, called *transpiration factor*) is most favorable. The author, to show the value of this vegetation quotient in expressing weather conditions furnishes a table for the various stations under his observation, which give the following means:

	March-April	May-June	July-August	Average
1902	28	20	14.1	20.7
1903	33.9	11.6	23.4	23.
1904	22.7	10.	9.9	14.2
1905	34.7	8.2	12.9	18.6
Averages,	29.8	12.4	15.1	

A comparison of the curves of height growth with those of the vegetation quotients, especially in July-August of the previous year show obvious parallelism, the storing of reserve materials upon which the height growth relies beginning in July.

To explain the divergence of his results from Hesselmann's, the

author points out that for both spruce and pine Sweden is not an optimum region, precipitation generally being higher than evaporation, hence the warm dry summer is an improvement on the usual climate, and the result in growth and storage of materials an increase. In other words the influence on height growth by the meteorological factors of July-August of the preceding year occurs in positive or negative sense according to whether the abnormal weather conditions compared with the normal is an approach or a departure from optimum conditions of vegetation. A similar law will be found exemplified further on in regard to diameter growth. These observations make clearer what "optimum locality" and climatic zones really mean.

The relation of weather to diameter growth has been before developed by Friedrich, who discovered that the weather of the year's growing season is determinative, while Schwarz in his work on the pine assigns to the temperature of the months January to March the most important influence on the amount of increment; on dry and medium moist soils, i. e., under normal conditions. He found that early beginning of warm weather in spring produced large, retarded spring small increment.

Cieslar secured his data by means of a Pressler borer on cores taken breast high for a series of years, including the drouth year 1904, on a variety of species, ages and sites, the ring growth being examined with a magnifier of 23 diameters. The data of 131 trees, which include measurements of the summerwood per cent., are tabulated in full on 16 pages.

We can give only samples and have selected the two species for which Prof. Buckhout brings data in this issue (see p. 259), together with deciduous species for comparison, leaving out some of the data of site and character of tree. Unfortunately the summerwood per cent. was not in all cases measured.

These data as well as all the others with few exceptions show the detrimental influence of the summer drouth in the year of its occurrence on diameter growth, proving that temperature and moisture conditions after January to March have a decided influence, contrary to Schwarz, especially since the weather conditions in 1902 and 1905 did not produce any proportionate diameter growth. Those specimens which did not react to the drouth were found near water courses, and those reacting only slightly

Species.	Elevation.	Exposure.	Age.	Width of ring. *m m*			Summer wood, per cent.		
	m.			1905	**1904**	1903	1905	1904	1903
Pinus Strobus, . . .	400–500	plain open	65	2.31	**2.13**	2.58			
Larix europæa, . .	1200	S	15 (?)	3.30	**4.11**	2.58	27	**51**	40
" . .	1400	N	old	.12	**.15**	.15	not noticeable.		
" . .	1400	S	young	3.90	**5.70**	6.	35	**17**	15
" . .	1400	N	old	.18	**.27**	.30	33	**22**	20
" . .	1000	E	old	.78	**.51**	.36	38	**18**	25
" . .	500	W	25–30	2.35	**2.70**	3.65	21	**26**	38
Fagus silvatica, . .	500	plain	6 inch	2.70	**2.25**	2.55	15	**12**	12
" . .	650–750	"	60	2.25	**2.40**	1.75			
" . .	1450	SW	60	.65	**.95**	1.50			
Quercus sessiliflora,	320	N	60–80	2.64	**2.07**	2.85	57	**50**	37
"	320	S	old, open	1.35	**1.35**	1.50	77	**51**	67
"	350	S	30, sprout	1.50	**1.20**	1.50			
"	400	——	old	1.44	**1.35**	1.65			
Pinus sylvestris, . .	300	plain	very old	.48	**.96**	.96	25	**9**	31
" . .	320	S	18	.66	**1.74**	2.04	24	**10**	23
" . .	320	S	12 inch d,	2.55	3.24	3.96	41	**16**	45

came from fresh soils, or else were situated in districts which demonstrably had not experienced the drouth.

A special series of measurements on 50 pines from one district show strikingly not only the effect of the drouth, but its after effect in the following year, which was also hot although rainy.

Highly interesting is the observation that in higher elevations (1400 m), although drouthy conditions prevailed in 1904 and 1905, of 16 trees only 4 showed minimal reduction of increment, while the others made even larger increment. This observation coincides with that made by Hesselmann in Sweden. With elevation we depart from the warmer optimum, when higher temperature and less precipitation become favorable factors. Two spruces standing on a swampy meadow most strikingly showed the benefit of the drouth year in increased increment. A southern, steep exposure may, however, wipe out the advantages, as is shown by another series of measurements.

Very striking is the influence of the drouth on the summer wood per cent. with very few exceptions, sometimes to the extent of practically wiping out summer wood formation. Losses from the normal 19 per cent. to 3, 31 per cent. to 9, 62 per cent. to 32, 37 per cent. to 4, 43 per cent. to 13, 45 per cent. to 16, 31 per cent. to 7, 41 per cent. to 10, are noted in the neighboring rings. Usually the color of the summer wood is paler, so that not only

amount but structure seems to be influenced, and that means the quality of the wood (lighter)!

It is well known that in conifers as a rule with the broadening of the annual ring the summer wood per cent. decreases and the quality sinks and *vice versa*. In the abnormal drouth (hunger!) year this rule is entirely lost: the smaller rings are absolutely and relatively reduced in summer wood and hence furnish poorer wood.

There are, outside of Sachs' bark pressure theory, two theories regarding the formation of spring and summer wood. R. Hartig refers the thin-walled springwood to poorer nutrition and the necessity of forming conductive tissue, the thick-walled summerwood being referred by him to better nutrition during the warm and sufficiently moist summer. Wieler, on the other hand, claims that the more unfavorable the conditions of nutrition the slower the development of assimilating organs, hence the more summer wood.

The author inclines from the data collected to side with Hartig's conception. That conditions of nutrition are responsible is also made evident from the observation that even in the cases where the ring of 1904 was as broad or broader than that of 1903, the summer wood in the former was percentically and absolutely smaller than in the latter year.

Einige Beziehungen zwischen Holzzuwachs und Witterung. Centralblatt f. d. g. Forstwesen. June, July, 1907. pp. 233-246, 289-311.

Effects of Drouth on Increment.

A further contribution on the influence of weather on increment is brought by Böhmerle, who studied the effects of the drouth of 1904 on the various experimental areas of the Austrian Experiment Stations.

Speaking in general on the influence of weather on increment the author quotes Dr. Pokorny, from an address delivered 40 years ago, as follows:

"The conditions which now retard, now promote the increment of trees are partly constant, partly temporary ones. The latter, like open position, severe wounds, etc., show mostly very obvious effects on the annual ring, which as a rule are readily recognized as abnormal. The constant factors, like site, age, character of

species, can be calculated, and only one factor remains, which in the great average is constant, but in the single years varies, namely the weather conditions. The principal sign by which the influence of this factor can be recognized is that all trees of a region of equal weather conditions must show its effects no matter what age or other conditions might be. In this manner the annual ring becomes a phenological datum, and it is only necessary to find a proper method of observing it. The best basis for such is to make comparative studies of annual rings of the same years, to find years of special meteorological character in the cross section of trees and relate them to weather records."

The various experimental areas of the Austrian Station, which are annually carefully calipered gave a special opportunity for relating the performance during the drouthy year 1904 with preceding and subsequent years. Eleven such areas, mostly thinning areas, were utilized.

Without going into details, we have from the data furnished made the following tabulation, the Roman numbers referring to various measured areas, variously thinned and of varying density, the percentages being related to the cross section area of the year 1900 or some other one year preceding the drouth year:

Cross Section Increment Per cent.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X
1901	2.8	3.9	3.	3.8	4.8	5.6	...	...	...	...
1902	2.6	3.4	2.1	3.2	4.2	5.4	...	...	...	...
1903	3.	4.3	2.2	3.	4.2	5.9	1.6	2.3	3.5	3.8
1904	**2.1**	**2.8**	**2.1**	**2.7**	**3.1**	**4.1**	**1.4**	**2.2**	**2.7**	**3.1**
1905	2.	2.5	1.6	2.5	3.6	4.2	1.8	3.1	2.8	3.5
1906	...	...	2.8	3.4	4.	5.1	...	...	...	...

	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
1902	....	....	....	2.7	3.8	4.1	3.9	4.4	4.4	4.9
1903	15.4	10.4	11.8	1.2	2.1	2.5	2.1	3.2	3.3	3.5
1904	**18.6**	**9.6**	**11.8**	**0.9**	**1.4**	**1.7**	**1.6**	**2.3**	2.7	3.
1905	33.8	13.9	17.5	1.3	1.8	2.5	2.2	2.9	2.4	2.6
1906	26.2	12.3	15.3	...	...	...	...	3.	3.3	3.5

The losses of increment, as is evident are felt in most cases in the following year as well as in the drouth year. They vary in amount from a fraction to 1.8 per cent. in the different areas. The more open the areas, as is to be expected, the more severely they suffer. For some of the areas the loss in dead trees per ha. is recorded, as for instance:

1903	8	16
1904	**68**	**60**
1905	20	112
1906	0	...

In one of the areas not included in the table Austrian Pine, 82 years old, on diluvial soil with impenetrable subsoil at 24 inches, the increment loss during the drouth year figured for variously thinned stands as much as 1.8, 2.5, 3.6, 3.5 per cent., the more open stands showing the greater loss.

An area of the same species and character in which on one part (I) the litter is not removed, on a second (II) is removed annually, on a third (III) only every five years, showed the following losses: I, 3.8 %;, II, 3.4 %; III, 3.9 %; the first and second suffering alike, a two year layer of litter being sufficient to eradicate the difference.

On two areas used for fertilizer experiments, the one with the litter hoed under every 3 years, the other under removal of litter every 3 years and surface dressing of street manure showed the following increment and loss per cents.:

	I		II	
	Increment	*Loss*	*Increment*	*Loss*
1903	5.8		5.5	
1904	**3.3**	**2.5**	**2.6**	2.9
1905	1.3	4.5	1.3	4.2
1906	5.6		5.4	

The loss of increment in these cases is repaired in the second year due to the soil improvement in 1905.

The influence of the drouth on height growth in young plantations in the years of drouth and the subsequent one is strikingly exhibited in the following table giving the annual average height growth in four 10 to 15-year-old plantations of spruce:

Year	I	II	III	IV
		Meter		
1902	.58	.49	.61	.44
1903	.37	.35	.52	.44
1904	.27	.25	.27	.20
1905	.31	.12	.21	.18
1906	.49	.21	.52	.35

At another place entire plantations up to 15 years of age are reported to have died, even the frugal birch succumbing.

Lastly, areas used for irrigation experiments are investigated as to the loss in different stem classes. Naturally the unirrigated area suffered more than the irrigated, but it is less directly evident why the middle classes suffer more than the stouter or smaller trees, and why the subsequent year shows greater losses. The losses in the drouth year and the year following were:

	Class	*Irrigated*	*Non-irrigated*
1904	Lowest	.48%	.22%
	Middle	.92	.81
	Stoutest	.17	.12
1905	Lowest	1.	.70
	Middle	1.41	1.31
	Stoutest	.18	.81

The stoutest class reacts less to the irrigation as well as to the drouth (deeper root system?), the medium class is most benefited and damaged, the lowest responds relatively less in both directions.

Die Dürreperiode 1904 und unsre Versuchbestände. Centralblatt f. d. g. Forstwesen. May 1907, pp. 192-208.

Influence of Frost on Diameter.

Dr. Friedrich, with the aid of his ingenious auxanometer (see QUARTERLY, Vol. IV, p. 52), has been studying the influence of weather on increment, and especially the influence of frost on diameter. The results of observations through three winter months on maple, basswood and spruce are graphically presented, on other species in tables, and show a decided parallelism between temperature changes and diameter variation.

In these studies the fact has been demonstrated that even during the winter rest the diameters of living trees remain rarely constant. There is no difference in this respect between the leafless trees and the leafy conifers, the transpiration of the latter in an air of prevalent high relative humidity making small difference. In temperatures above zero (c) the diameter changes show contradictions, which the author believes due to the partial influence of the sun, and also to the shading influence of the crown, as in spruce. A short duration of frost conditions effects

little diameter variation, but continued frost weather effects first slowly, then more rapidly a decrease in diameter which may amount to maxima of 230 *mm* in basswood, 85 *mm* in maple, 145 *mm* in spruce, 70 in white pine, etc., the different species reacting very differently.

A beech stand was carefully calipered in mild and frosty weather, the result even by this cruder method showing a decrease of 4 *mm*. Measurements of freshly felled logs in frosty weather would also show decreases, but, owing to the varying moisture per cent. a direct proportion could not be established.

Ueber den Einfluss des Frostes auf den Durchmesser lebender Bäume. Centralblatt f. d. g. Forstwesen. May 1907, pp. 185-192.

SOIL, WATER AND CLIMATE.

Preservation of Soil Fertility.

After having described conditions of pastures and forest in the Alps and Jura, and especially the wasted pastures, which fail to be useful, Pillichody points out that here the forest is the only practicable and cheap means of improvement. That forest cover improves the soil is proved by the fact that even on poor soils forest growth not only thrives at the start, but if properly treated its yield increases and it advances into a better site class. Soil physicists explain this soil improvement by the leaf fall; the constant, moderate humidity, the rapid oxygen production, which together with the even temperature favors humification; porosity and full aeration of the forest soil, which promotes the decomposition of the mineral constituents. This did not, however, explain why with intensive utilization of the wood, i. e. removal of these materials, especially nitrogen, the soil fertility did not retrograde. Not until Hellriegel and Willfarth in 1888 demonstrated the capacity of certain plants, especially leguminous ones of accumulating nitrogen from the air, and Henry of Nancy showing in 1894 that the decomposing leaf litter has the same capacity under cooperation with micro-organisms was the enigma solved. In 1905 Süchting, Montemartini, and Wiesner have fully verified this latter discovery. The annual enrichment of the soil by this means may vary from 10 to 20 pounds per acre, a production which

assures the highest wood production without deterioration of the soil. Hence, the writer argues, on worn-out alpine or mountain pastures the coming in of trees should not be prevented but encouraged as a welcome natural rotation of crops.

Ueber Erhaltung der Bodenkraft der Wytweiden. Schweizerische Zeitschrift für Forstwesen. May, 1907. pp. 162-165.

Influence of Forest on Ground Water.

In spite of the strenuous efforts to make the climatic influence of forests the prominent argument for government forestry, this function is by no means fully demonstrated and the latest publication from the Russian Forest Experiment Station this year by Otozki makes at least a favorable influence on the ground water level doubtful as a result of 15 years of investigation. The very painstaking work is reviewed by Guse. The literature on the subject is more or less fully cited and the author himself acknowledges that he began his investigations convinced of the importance of the influence, hypnotized as it were by the generally accepted theories, and when his results brought out other conditions doubting them at first himself.

Investigations of Wollny and King left no doubt as to the lowering of the ground water level by forest growth, and Otozki's very extensive observations, which are described in detail, confirm that in all variations of topography, geological formation, time, plant cover, etc., without exception, the fact appears that under the forest the first horizon of the ground water during the period of vegetation lies lower than on the neighboring uncovered area, and indeed sometimes vanishes. The difference of the levels in and out of forest varied between 5 and 3 m. physico geographic factors explaining the variation.

Similar observations as those made in the forest regions were made in the steppes or plains and in the forest islands of the same, as also in the artificial plantations; always with the same result.

All the exhaustive investigations permit the following deductions by the author:

1. In consequence of the rapid transpiration the forest consumes more moisture than under otherwise similar conditions on open area or one covered with other vegetation.

2. The average amount of the transpired moisture in the forest approaches the average precipitation. In the cold humid North it is often less, in the southern latitudes more.

3. These facts occasion everywhere more or less depression of the water table within the reach of the root system.

4. The nearer to the surface the water conducting horizon, the more pronounced is its lowering, the easier the re-establishment of the *status quo ante;* the lower it lies, the smaller but the more permanent the depression.

5. With low ground water level and water consumption active, the lowering of the water takes place principally in summer. Later there is a tendency to equalize with the water table of the neighboring field. If the water conducting layers contain only little water it often vanishes entirely under the forest cover.

6. With the age of the forest its depressing effect increases to a certain degree and then remains constant.

7. The usual deficit caused by the excess of transpiration above precipitation is covered by the waters of the neighboring open areas, mostly subterranean.

8. In consequence there occurs in the neighboring areas a temporary or progressive lowering of the water table, the extent of which depends on physiographic conditions, among others on the size of either forest or field.

9. With small areas and slow water conductivity the yearly balance is variable, which not rarely leads to a progressive lowering of the water table in the forest as well as in the adjoining field.

10. The depressing influence of the forest is so great, that it often masks or even paralyzes the hydrologic influence of geological, orographic, meteorological and other factors.

11. The difference between deciduous and coniferous forest is not entirely established, appears, however, not great, since the lower transpiration of the latter is to an extent compensated by its longer duration and the interception of a considerable amount of the precipitation by the foliage.

12. The doctrine of the hydrologic activity of the forest is a physiographic ideology, which is contradicted by exact observations and investigations.

The question as to what becomes of the enormous volume of

water transpired by the forest, its influence on rainfall, etc., or the general beneficial influence of forests is not touched. To the student of natural history, the author pertinently remarks, there is nothing beneficial or the opposite in nature, only law and instruction.

Die russischen Untersuchugen über den Einfluss des Waldes auf den Grundwasserstand. Centralblatt f. d. g. Forstwesen. July, 1907. pp. 311-318.

Forest Influences in General.

There is hardly a question farther from being settled, or, we should perhaps say, lately become again more unsettled than that of the influence of forest on climate and water conditions. The above briefed results of Otozki (who by the way is a geologist) are, to be sure, only applicable to the plain country and do not apply to water conditions in the mountains. Nor, have any of the other investigators of ground water levels—Henry, Ebermayer, Hartman, Wollny (the latter in small box experiments)—had opportunity to study the behavior of mountain waters and the influence of mountain forests.

In a very illuminating report before the International Forestry Congress at Vienna this year, Dr. Fankhauser rehearses what knowledge exists or rather the lack of definite knowledge upon which the argument of forest influences rests. Diametrically opposite opinions have been based upon observed facts. Surrell seemed in 1841 to have beyond peradventure proved the beneficial action of forest cover on torrents. On the other hand the hydrographers Lauda in Vienna, Honsell in Karlsruhe, Hensel in Munich, Cipolletti and Ponti in Rome, Keller and Wolfschütz in Brünn have denied wholly or partially the influence of forests on floods, the large floods being caused by climatic conditions which render the forest influence zero or so small that it may be neglected. These maintain that the amounts of water of severe and continuous flood rains are so large that the water taken up by the forest is relatively small. This is undoubtedly true, since, according to Hoppe, a 60-year-old spruce forest intercepts in its crowns of a precipitation of 20 *mm* only about 6 *mm*, a pine forest about the same, a beech forest half that amount, probably somewhat more in heavier precipitations—in the mountains

thunderstorms precipitate 60 to 80 *mm*, continued land rains several hundred millimetres (408 *mm* measured). The forest cover, litter and moss, may absorb, according to Ney-Ebermayer at most 1.80 *mm* in spruce stands, 2.82 in pine, and 2.36 in beech. Transpiration while the air is near saturation, can be only minimal. In the most favorable case the forest would, therefore, reduce the waters by 10 to 15 *mm*, the balance *as soon as the forest soil is soaked* would have to flow off superficially. Actual experience, however, has abundantly proved the favorable influence of forests and reforestation on the regime of torrents, and we come readily to the conclusion that this must be due not to the absolute capacity of retention, but to the ability to *retard the run-off*, to distribute it over a longer period. Real torrents originate as a rule in consequence of unusually severe but short rains of limited area, and usually in the summer time when the retentive capacity of the forest is at a maximum. Then, on the steep slopes of the upper water basin, when only a few minutes would suffice to collect and discharge enormous water masses the retarding effect of the forest cover becomes of value.

The floods in large rivers are conditioned by quite different phenomena, rapid snow melting and continuous rains. Here the value of the retarding quality becomes nugatory, and, even with the same forest per cent. the effect of an intensive precipitation will be different in each case. Nevertheless, even here, the forest has its value, for, besides the water volume there is to be considered the erosion and detritus carried by the river, which have a very important bearing on floods. This office is freely acceded to by nearly all authorities as commanding conservative, rational treatment of mountain forests. Thus the hydrographer of Hungary, Krassay, states: If the considerable shortening in the length of the important Hungarian rivers has not led to their being filled with debritus *(Geschiebe)*, this is due solely to the strict measures for the preservation of the mountain forests.

Nevertheless, the author contends, we cannot be satisfied either with these general statements and arguments or with the opposite general assertions of hydrographers.

All the general assertions that are found in the literature need more careful investigations. The author questions, for instance, the long accepted idea that owing to the root system of forest

growth the soil is made stable by forest growth and less liable to landslide and erosion, when only crowns and soil cover are the really effective agents. Hence the often advised clearing on territory which shows movement "in order to remove weight," is a mistaken measure; hence also the value of coppice is less than of deep rooted, fully crowned timber forest. The general assertion of the forest influence on snow melt also needs closer study. In referring to Otozki's observations the author announces that similar investigations into ground water conditions have been made by the Swiss stations and will soon be published. The author closes with a resolution that in all governments concerned a thorough scientific investigation of the subject on a uniform plan be secured.

Wald und Wildbâche. Schweizerische Zeitschrift für Forstwesen. July, Aug. 1907. pp. 197-202, 236-244.

Effects of Tree Roots and Grasses on Soil.

An interesting cause of competition between different crops is worked out by Chas. A. Jensen of the Bureau of Soils. Noting the frequent failure of grass under the drip of trees, the author discusses and dismisses as insufficient the usual explanations of shade, withdrawal of nutrients and of water by the trees. He also refers to experiments by the Duke of Bedford in trying to find the cause of the deleterious influence of grass on apple and pear trees in which the conclusion was reached that the effect was due to poisonous substances in the soil around the tree roots, leaving the question open as to whether these substances were due to direct excretions from the grass or to a changed bacterial action in the soil induced by the grass.

A similar relation between *Juglans cinerea* and the shrubby cinque foil, *Potentilla fructicosa*, the latter being killed by the former, was demonstrated by Jones and Morse, and other such relations have been shown. The author made a series of tests with tree seedlings of maple, dogwood, cherry, tulip, pine, sowing wheat in the same pots, with check tests without the trees. From these pots nine crops of wheat were harvested with the result that all pots planted with seedlings yielded less in the average than

the check pots, although in several cases the single crop yielded more. The retarding influence differs with different species, maple and pine apparently the most, but it would be hazardous from the experiments to establish a series. The injurious effect of the trees on wheat are referred to toxic excretions, because, the author states, other conditions could not have been influential.

Science, May, 1907, pp. 371-874.

SILVICULTURE AND PROTECTION.

Method of Mound Planting.

On dry, shallow limestone soils Mathey of Dijon has practised with satisfaction the following method: In the fall before the planting year, short ditches are made 20 inches wide and about 30 inches long, down to the rock or at least to 12-inch depth. The soil is laid down on one side, rock material on the other, preferably the southern. This soil is left to itself for a year, so that it will be thoroughly decomposed, aerated and mellow, and enriched with nitrogen. The planting is done the next fall. The ditches are filled first with sod from the neighborhood, then with the loose soil so that the planting bed reaches 4 to 6 inches upon the surroundings. In these mounds moisture is better retained by the loose soil and weed growth cannot at once compete with the trees. If planting is done in holes or in depressions the soil quickly settles and the plant standing deep soon dries out.

There may be 160 mounds to the acre, and 4 to 10 plants per mound, which, leaving all existing volunteer growth and shrubbery, is considered sufficient as a base, to be filled out by natural volunteer growth. The cost, when 8 to 10 plants (1,450 to the acre) were used at $1.10 per M, was altogether $24 per acre.

In spite of the unusual drouth of the summers 1905 and 1906 the plantings stood perfectly and hardly four fail places per acre had to be replanted.

For very poor soils, the addition of mineral fertilizer, 400 lbs. Thomas slag and 150 to 200 Kainit per acre, are advocated.

Hügelpflanzung auf trockenem, flachgründigem Kalk. Schweizerische Zeitschrift für Forstwesen. June, 1907. p 169-170.

Method of Composite Forest.

A somewhat extended discussion by Hamm gives an insight into the methods and results of composite forests in the overflow lands of the Rhine Valley.

There is, no doubt, that in the United States, especially in farmers' woodlots, this method of management will eventually be largely employed, but it is questionable whether first-class agricultural land, if capable of drainage, will be so used.

It consists, as is well known, of a combination of coppice with seedling or coppice overwood, all age classes mixed as in the selection forest, the rotation of the different parts of the overwood being a multiple of the rotation of the underwood or coppice.

As an argument for the composite forest with hardwoods, the following interesting statement is made: With conifers, clear bole and cylindrical trunk are the main issue, and these qualities are of much greater influence in making price than the diameter; with hardwoods the reverse is the case, as was evidenced by recent sales in the Black Forest, when for Spruce logs of 10-inch middle diameter 14 cents per cubic foot was paid, while 16-inch logs brought only 3 cents more. On the other hand, Ash of the same size brought 18 cents for the smaller and 55 cents for the larger dimension; Oak, 15 and 28 cents respectively; Maple, 14 and 28 cents; Elm, 11 and 25 cents; Poplar, 13 and 26 cents. Hence, the argument is made, the aim should be to secure in shortest time the stoutest dimensions. Of course, clear boles are also more desirable in hardwoods than the branchy tops, yet the latter are always salable, and crooks, especially in stout dimensions, are no detriment, sometimes even an advantage (for wagon and shipbuilding).

The composite forest is then to be specially employed for the growing of stout dimensions. That it is mainly the time element in securing stout sizes which is the advantage of the composite forest (wherever all the material is salable!) is shown by a comparison of actual results from timber forest and composite forest on I and II site, these results being, so it is said, also characteristic and similar in the hill country.

In 100 years the timber forest furnished 9870 cubic feet, be-

sides 5358 cubic feet in thinnings, or 152 cubic feet per acre and year. The composite forest during the same time would have given only 110 cubic feet.

The calculation of assortments and returns per 100 cubic feet would have been for the composite forest:

20 cubic feet of 16 inch and more at 64 cents =	$12.80
25 cubic feet of 10 to 16 inch at 35 cents =	8.75
10 cubic feet below 10 inch at 21 cents =	2.10
23 cubic feet billets at 7 cents =	1.61
17 cubic feet brush at 5 cents =	.85
5 cubic feet bark	
	$26.11

To which an addition is to be made for four thinnings with 700 cubic feet at 4 cents. The total returns for the 100 years, then figure up in round numbers to $2,630, while the returns from the high forest, with hardly any difference in the more valuable assortments, figure up to $2,900. If, however, the fact of the earlier returns in the composite forest is taken into consideration with a compound interest calculation at 3 per cent., the timber forest in the 100 years has produced only $3,790 as against $11,000 for the composite forest.

Regarding the management of the composite forest the following hints may be of interest. A proper conception of the crown area which the overwood is to occupy is very necessary if satisfactory silvicultural results are to be attained. If at the end 70 per cent. of the area is to be occupied by overwood, then under the conditions of the overflow lands under consideration at the beginning of the rotation it must not occupy more than half, or 35 per cent., to prevent closing up and choking out.

The final distribution might be as follows:

Coppice, at end of 25 year rotation,	0.3 of area =	7.50
Oak, with 125 year rotation,	0.2 of area =	25.
Ash, with 100 year rotation,	0.15 of area =	15.
Poplar, with 50 year rotation,	0.20 of area =	10.
Elm, with 75 year rotation,	0.15 of area =	11.25
Average rotation,		68.75

Since coppice shoots outgrow seedling growth until about the 10th or 12th year, the latter must be protected by timely thinning, first in the 3rd to 5th year, then in the 9th to 12th year, when some money can be made from the thinning; in the 18th

year a third thinning with about 250 cubic feet to the acre will be found desirable.

The cut is then made in such a manner that the aimed-at distribution (as above) is attained at the end of the next rotation. The species should be distributed according to soil conditions, the more frugal on the poorer sites; if in groups, these should be open, so as to secure continuously the advantage of the composite forest, *i. e.,* increment due to open position.

It is, to be sure, also admissible to have timber forest groups, *e. g.* of conifers; but they must be grown in dense position from the start, not forced into it from the original overwood position. The selection of appropriate overwood, when the felling is to be made, is important. Those with poorly developed crowns are undesirable, the poorer the crown the sooner water sprouts will form and the pole will be crippled. At first a larger number is left, when after two years or so the less desirable are removed. In cutting in the overwood, not only the mature, but all those trees of younger classes are taken which have an undesirable crown and would interfere with better material; it may be preferable to leave a tree with a moderate frost split than a poorly crowned one which does not produce and which damages its neighbors. The stout ones which promise well are, of course, to be favored. At the time of the cut, pruning may also be done by taking away water sprouts and shortening overlong branches on older, or on younger ones cutting the latter off. Of course all the precautions of good pruning must be kept in mind.

When planting to repair the overwood, it must be kept in mind that on account of the rapid development of the sprouts, the plant material must have an advantage in height, and be set 8 to 10 feet from the stocks, say normally at the rate of 50 to 80 plants (poles) to the acre, to be set in spring into holes made in the fall 16 inches deep and 24 inches wide. Oak, Ash, Maple, Elm, Black Walnut, Poplars, Birch, Basswood, Willow are fit species.

The rotation of the underwood is preferably kept between 20 to 25 years, when the stocks sprout best; for poplars and willows 15 to 20 years suffice. In these overflow lands our cottonwood makes in 50 years 28 to 32-inch diameters, and remain perfectly sound.

The cut may be regulated by estimating the stock and utilizing

$\frac{r}{2}$, using for r the average figured as above. The rest is proper silviculture.

Auen-Mittelwald und Lichtwuchs. Schweizerische Zeitschrift für Forstwesen. May, June, July, 1907, pp. 149-155, 197-208.

Heck's Method of Thinning.

In an explanatory note, trying to set right Hess' strictures (in Heyer-Hess Waldbau) on the Freie Durchforstung of Heck (see QUARTERLY, vol. III p. 40) which might be translated into Individualized Thinning, Heck protests against the assumption that he proceeds without rule or direction. The freedom which Heck advocates is the absence of a scheduled form and predetermined degree of thinning; the principal thought is to select and favor the best shaft forms in graded stem classes, based on the observation that the best stem forms also make the largest increment.

Für die freie Durchforstung. Allgemeine Forst-u. Jadgzeitung. July, 1907, pp. 240-243.

Damage by Noxious Gases.

Damage suits by owners of timberlands and other property against metallurgical works, emitting noxious gases, especially sulphurous fumes have lately become frequent. The difficulty is to establish beyond doubt the claim that the fumes are the real and only cause of the damage. To expedite such investigations Forstrat Gerlach at Waldenburg, Saxony, has constructed and described a complete, yet convenient apparatus thoroughly tested in ten years' experience, the special feature of which is that aspirators are connected by rubber tubes of varying length with the chemical apparatus, so as to secure air from different strata. The reagent recommended is a 5 per cent. solution of purest potash (carbonate) to which bromine is added until slightly yellow. Details of construction and use are given, as also the results of trial analyses. A feature of the apparatus is the addition of a Woulfe bottle to the usual potash apparatus to avoid a source of error which comes from the uneven, jerky movement of the gases caused by mechanical impediments in the potash apparatus, and causing a partial uncontrollable displacement of reagent solution into the connecting tube.

The best time for measurements is in the fall when winds are more steady and strong. Especially steadiness is of importance, as it insures sufficient amounts of collected gases, which should not be less than 2 to 3 cbm, or 2,000 to 3,000 liter. The writer points out that the diffusion with distance and consequent decrease of damage can only be determined by simultaneous use of similar apparatus. According to Stöckhardt and Schröder the minimum of innocuousness of SO^2 lies at the proportion of 1 in 1,000,000 of air; according to Wislicenus an obnoxious effect on spruce and fir cannot be confirmed at less than 1 in 500,000. The author properly contends that site and continuity of influence must be important factors in this proportion. His measurements prove that the decrease in concentration does not take place in direct proportion to the distance. Taking into consideration the time element of influence, the author inclines to agree with Stöckhardt and Schröder's minimum as the lowest permissible concentration.

Separates of this article can be had for MK 1.20 by application to the author.

[In this connection we call attention to a most valuable compilation of the literature on this subject (the best in English) by Dr. Persifor Frazer, printed in the Transactions of the Institute of Mining Engineers for 1907, to be also had as separate.—Ed.]

Ein Apparat zur qualitativen und quantitativen Ermittlung der aus industriellen Etablissements entweichenden sauren Rauch-und Abgase. Allgemeine Forst und Jadgzeitung. May,, 1907, pp. 150-157.

Use of Insect Lime.

Although we are still in the period of forest exploitation, when the finer methods even of forest protection are still impracticable and insect pests are simply to be endured, hardly to be systematically fought, yet the time will come soon when other insect pests than the gypsy moth will call for thousands of dollars of annual expenditure, and it behooves us to become familiar with effective methods.

A leaflet issued by the Imperial Biological Institute for Agriculture and Forestry describes proceedings against the pine spinner (*Bombyx pini*).

If trial collecting develops at the foot of trees (10 to 20 per ha.) 15 to 20 caterpillars per tree in thickets, 30 to 40 in pole-

woods, 50 or more in timber woods, it becomes necessary to prepare for combat.

Properly placed bands of insect lime are entirely effective against this pest. Before liming the stand should be thinned, partly to save liming, partly to make it more effective; for smaller suppressed trees or underwood furnish bridges which enable the caterpillars to reach trees above the bands. Then each tree is to have a ring of 8 to 10 inch width, the rough bark to be removed without damaging the cambium. The band of lime is then applied by a rapid working instrument (Boden's or Fiss) which makes an even application 3 to 3½ *cm* wide and .4 *cm* thick. This liming must be finished by end of March. The amount needed is 50 to 60 kgs. per 1 ha., the cost, varying greatly, under normal conditions should not be more than 16 to 18 m per 1 ha., say $1.75 per acre with wages as given on p. 352 of this issue.

Der Kiefernspanner (Bombyx pini). Centralblatt f. d. g. Forstwesen. May, 1907, p. 215.

Birds in Forestry.

In a long article Dr. Schinzinger accentuates the great value which the fostering of insect-eating birds has in forest protection, and the great necessity of general recognition of this fact. And this means not only care for the useful and prevention of the destruction of species which, although occasionally undesirable, are yet essentially useful.

The investigations of stomach contents have disproved the idea, that birds destroy noxious and useful insects together; in the main they feed on the former. An effort to secure coöperation has been made by the Prussian Minister of Agriculture, issuing in 1906 a pamphlet of instructions, but these must be modified according to local conditions.

The author then discusses under six heads the measures which are required to secure effective bird protection.

Energetic suppression of indiscriminate shooting of birds; persistent and rapid reducton of the actual enemies of our useful birds, among which are mentioned cats, hawks and falcons; furnishing breeding places for dwellers in hollow places which through culture have been deprived of these; preservation of

shrubs, especially thorny ones and berry shrubs, which are being reduced by the progress of cultivation; winter feeding; spreading of knowledge and special instruction to game and forest wardens.

The cultural importance of a number of birds on the value of which mistaken notions exist, is specially discussed. Owls, buzzards, and some other rapacious birds are more useful in catching mice than obnoxious in killing birds. *Circus cyaneus* and *cineraceus* of the crow family are good mousers, while *Circus aeruginosus* is most obnoxious to birds breeding on the ground. *Corvus corax* and *monedula* are great robbers, but *Corvus frugilegus*, although omnivorous, and especially feeding on the farmers' crop, and robbing birds' nests, does nevertheless more good than damage by destroying worms, beetles, pupae, larvae, etc Hence in this case only a prudent keeping in check, not extinction is indicated.

Indeed, Naumann asserted that in the end every bird does more good than damage.

Lanius excubitor is an unmitigated bird killer, but the smaller species of this family, contrary to general opinion, feed mostly on insects. Although woodpeckers may be classed as tree despoilers, eating seeds and ants, as well as insects, yet the author believes these too will be found more useful than obnoxious.

Moderne Forstwirtschaft und Vogelschutz. Allgemeine Forst-und Jagdzeitung. July, 1907, pp. 229-239.

MENSURATION, FINANCE AND MANAGEMENT.

Douglas Fir.

At a meeting of the Hessian Society of Foresters, Müller reports on the production of Douglas Fir in comparison with Norway Spruce during the first two decades in a mixed stand of 1½ acres, 18 years old from planting, northwest exposure, humous loamy soil, 200 m elevation. The planting was done with 4 to 5 year old transplants of spruce, and in every third row one Douglas Fir to two spruces. The Douglas Fir plants, 4 years old, were untransplanted stock of spindly and weak growth. For the first five years they made hardly any growth, then began to assert themselves, and now after 18 years

have suppressed the neighboring spruces entirely. At 17 years of age the dominant stand contained 544, the subdominant 134 trees, per acre; the diameters of the Douglas Fir ranged from 3 to 6½ inches, the average height 36 feet, the total volume 2100 cubic feet of which only 45% brushwood. Compared with spruce on best sites, the two species produce about the same yield but the timber wood per cent. in this case was higher, due probably to open position of the stand examined. Sample pieces of wood showed concentric growth in upper portions, but in lower sections the diameters in the direction of the rows were shorter than those vertical to this direction. Root development showed the same difference. Douglas Fir making both tracing and heart roots, stands, therefore, in its root system between spruce and fir. Other silvicultural advantages of the Douglas Fir were pointed out.

These results were obtained with the "green" variety. The "blue" variety, the speaker contended, lags behind the spruce and is less desirable than the green variety, except that it does not make summer shoots, which form on the "green" variety and are liable to frost killing. Another speaker assigns also a better quality of wood to the green variety.

Die 15 Versammlung des Forstvereins für das Grossherzogtum Hessen. Allgemeine Forst-u. Jagdzeitung. June, 1907, p. 222, 223.

Felling Budget in Selection Forest.

Mathematics and formulas, the basis of schematic and systematic procedure, have been introduced into forestry practice to secure a sustained yield, to make sure that we leave to posterity at least as much capital as we had received, and to ascertain the portion to which we are entitled.

The methods of forest regulation—regulation of the felling budget—in timber forest and coppice are well developed, but the selection forest has remained the step-child of regulation, probably because of the rapidly changing and seemingly lawless conditions of accretion, and the difficulty of ascertaining volume and increment.

An anonymous writer, V. G., discusses briefly the methods of a simplified procedure, based upon stem numbers, which he has ap-

plied in an Alpine selection forest of spruce with 1/10 admixture of fir, belonging to a canton in Switzerland.

As such procedure has been rarely discussed, we reproduce the author's exposition almost verbatim.

A regulation of the felling budget requires, of course, the ascertainment of the volume of stock on hand and of the increment or yield. After general inspection and suitable subdivision of the area, the first question to be decided is to what lowest diameter class to caliper for stock taking purposes, and to ascertain the percentic relation between the calipered and the unmeasured portions of the stand.

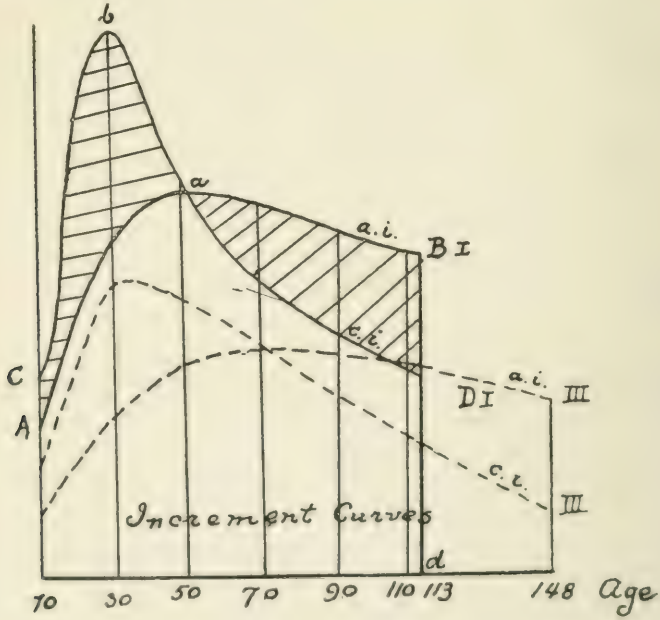
In the given case the calipering was done down to 16 cm (6 in.) by 4 cm diameter classes; plotting the numbers of stems in each diameter class as ordinates and diameters as abscissae, the resulting curve was found to approximate very nearly the curve of a compound interest series, *i. e.* the age class conditions were found approximately normal. Continuing the normal interest curve to the 8 cm (3 in.) diameter, the normal stem number for the lower diameter classes would be indicated. In the given case there was by trial measurement found very close approximation to this curve *i. e.* the stand was found normal in the lower classes also. The volume of these lower diameter classes was found to represent 8 per cent. of the total, which may then be considered a satisfactory reserve for this class of stands on sites of third class.

The determination of age in the selection forest is most difficult, especially for the lower diameter classes. Longer or shorter periods of suppression alternate with sudden or gradual transitions to normal or rapid increment. To place this irregular increment of the diameter classes in relation to time, as is necessary for budget regulation, is also a problem.

There is a difference made between the actual age and the "management" (Wirtschafts) age, which is ascertained for the period of suppression by a formula in which actual diameters are placed in comparison with normal diameter increment. The author proposes the construction of standard measures, based on ascertained average values for different sites, the subdivisions of which give annual average diameter increments. These are then to be applied in ascertaining the age of the suppression period. [See actual measurements on p. 199].

It has been proposed to dispense with age determinations in the selection forest and rely upon the current increment as a basis for budget regulation, but the author considers this procedure unsafe, because the current increment is extremely changeable and even more influenced by the condition of the stand than the average increment. A stand of second quality, shortly before cut over may show a larger current increment (due to light influence) than a fully stocked stand of first quality; or the diameter class of rapid increment may be present in larger number in the first stand than in the second. This age class (respectively diameter class) relation is of utmost importance in the selection forest in determining the budget, and unless it is employed as a corrective, the basing of the budget on the current increment may become fatal.

Even the average increment, or better, the sum of average increments is not a reliable criterion. Although the oldest age class may have attained the maximum average increment, the summary current increment of the *whole stand* is by no means equal to the summary average increment.



These two values are equalized the later the poorer the site. This is shown in the accompanying curves of average and current increments for spruce on sites I and III, the areas inclosed by each set in front and end part being equal *i. e.* the two values being equalized, the area $AabC = BaD$.

This on site I occurs in the 110 year, on site III it would be delayed till the 148 year. Silvicultural considerations (red rot!), would make it doubtful, whether such equalization is desirable.

In a given case the yield based on current increment was found 1100 m^3, based on average increment 770 m^3, a difference of nearly 50 per cent. Which would be nearer the truth? Would the average be more satisfactory?

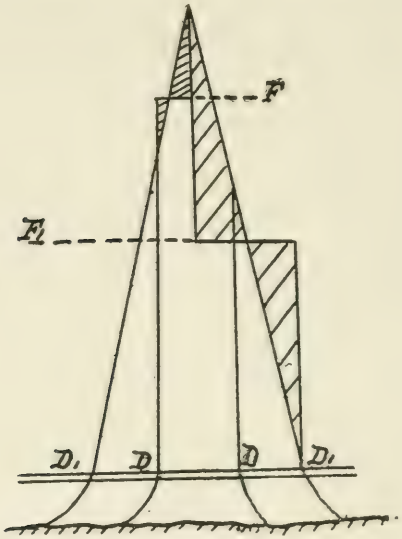
The author then discusses briefly methods of determining volumes. Since it has been shown, that even in the calipering of experiment areas errors of 2 to 3 per cent. in cross section area can occur, it would appear that the use of general volume tables (like the Bavarian) leads to sufficiently close results. Moreover if sample trees are selected after the Draudt method, which is usually done, *i. e.* a proportional number for each diameter class, a further source of error is introduced, for the higher diameter classes, which contain a small number but large volume, will be allotted few sample trees; the lower classes with large numbers but small volume a large number of sample trees.

To determine the form height ($\frac{\text{Vol}}{\text{area}}$) tolerably accurately, each diameter class should be allotted from four to five sample trees. A peculiarity of the form height, the author has found, probably occurring only in selection forest, is that in older trees it tends to sink. For this, the author offers the following explanation: In the higher diameter classes, height growth has ceased; the trees are mostly elite in open stand with free crowns. They are branched low, so that wind pressure produces increment mainly in the lower section, the form approaches more and more a cone, and hence form height sinks, as is graphically shown in the accompanying drawing, in which F is the form height corresponding to the diameter DD, F, to the diameter D, D.

The fact, that on one hand the current increment, however accurately determined, is so variable as to rule it out as basis for budget determination, and that volumes determined by form

height or by volume tables differ little, proves that a reliable basis for budget regulation in selection forest is so far lacking.

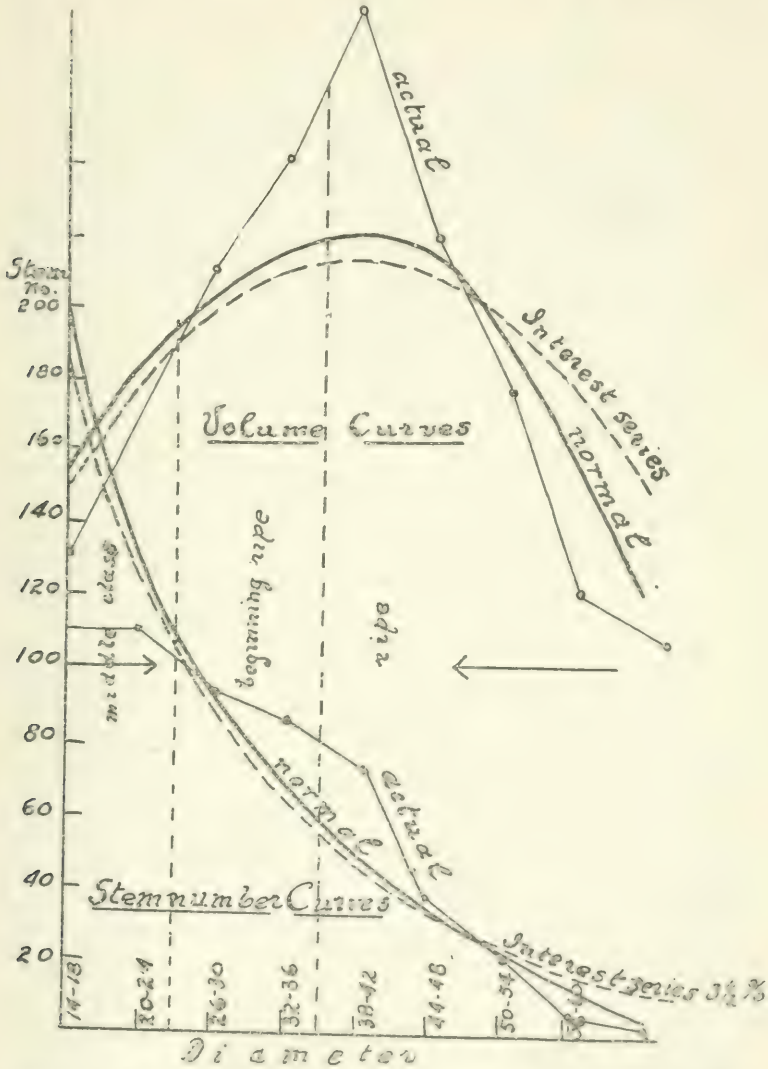
The author now proposes to utilize for this purpose the law of the decimation of stem numbers. The natural consequence of limited standing room, *i. e.* nutrition, is that the numbers in the



lower diameter classes are dependent upon those in the higher. If mature trees predominate, young and medium growth will be in the minority. Weber says: "As long as the period of rapid height growth continues, stem numbers sink according to the reciprocal series $\frac{10{,}000}{1.\ op^x}$, in which the denominator is an exponential function of time (10,000 being the area in meters of one hectar)—the curves of the diminution in numbers represent in a way the negative picture of the height curves."

This law is deduced from the behavior of even-aged stands, but it may be utilized for the selection forest, by conceiving the age classes of the separate areas in a compartment forest mixed, when the diameters would be conceived as functions of time and the stem numbers as moving in the same curve; this would be a normal selection forest to be used as standard for comparison

with actual stock. But while diameters are a function of age, the same diameter intervals are not conditioned by same time in-



tervals. It is a peculiarity of the selection forest, that the single individuals, escaping suppression at different times, exhibit the maximum area increment in different diameter classes. From

this, however, we can deduce that equal diameter intervals represent in the average equal time intervals, as is also shown by the results of about 1900 increment borings in diameter classes from 14 to 50 centimetres, and in altitudes from 900 to 1700 meters, which are tabulated.

Not only the result of the measurements, but a simple consideration shows that the higher diameter classes in the selection forest must be represented in the smaller numbers, since owing to their greater crown development they require larger standing room—and since the stem number is the result of total area divided by standing room of the single tree, the same area in the selection forest will give a smaller stem number. The normal curve in the higher diameter classes will decline more rapidly than the curve of the compound interest series, while in the lower diameters one or two age classes will be found crowded in the same diameter difference, and here the stem number curve will run above the interest curve.

A graphic representation of the diminution of stem numbers can be easily constructed for every stand and makes conditions of stock clear, and if compared with a normal curve, it becomes at once apparent where future management should interfere and how the stand is to be ranged in the felling budget. The use of the stem number curve is elucidated by an example from the actuality illustrated in the accompanying diagram. In this case the curve of actual diameter classes of 32 to 44 cm rise above, the lower ones below the normal curve, *i. e.* they show a deficit; hence, a cut (thinning) in the diameter classes 32 to 44 is indicated. By removing this surplus the young growth is freed and the deficit in the lower classes will slowly vanish. For sake of comparison the volume curves are also given, showing similar relationship.

The author then summarizes the procedure in determining the felling budget:

1. Caliper down to 16 cm (6-inch).

2. Analyze a few mature trees to determine site class and progress of increment.

3. Determine age and rotation.

4. Determine volume by form height, or if available, by volume tables.

5. Construct stem number curve and a normal curve for comparison.

6. Calculate average increment, based on age determination in the stem analyses for the different age classes, and add up to show the possibility (yield capacity).

7. Determine budget by use of Heyers' formula, basing *ni* (normal increment) by comparison with the possibility.

The advantage of this procedure lies in avoiding or reducing sample tree fellings and placing the criterion of stock conditions not upon vague increment data, but upon comparison of actual and normal numbers.

Einiges über Plenterbestände, deren Massen-und Zuwachsberechnungen Schweizerische Zeitschrift für Forstwesen. Apr., May, 1907, pp. 127-142, 156-161.

Working Plan for Selection Forest.

An article by Hobart-Hampden hits the nail on the head as regards the application of any budget regulation in the selection forest under the primitive conditions of India (and the same will be true for most conditions of this continent). The conclusion of the article contains almost all the argument: "There does not appear to be any necessity to insist on equal annual outturn, and with it normality in age classes; a 'possibility' check by number of trees cannot be anywhere near accurately fixed, nor, *a fortiori,* a 'possibility' by volume, and *may lead to unsilvicultural acts:* it is true economy to fell a tree when it is mature whenever that may be, and it is false economy to fell an immature, thriving and well-shaped tree. Therefore, for species to which the selection method is applicable, there is no necessity for expending time and money, as at present, in making enumerations for working plans, and an improvement felling based *only* on cultural considerations, in following out which the forest is constantly improving, is all that is wanted."

In the body of the article the writer explains improvement fellings as either excluding or including the regeneration idea. He has in mind the usually very irregular condition of forest growth, which falls into the hands of the forester, after most mature trees are removed and much badly grown timber left, interfering

with the better, which must be saved. Such a first improvement felling which does not include regeneration, the author proposes to call "transition felling," for this method is only provisional, intended to carry the forest through a short transition period and to be abandoned as quickly as possible when we pass on to a regular method—group method, selection, or successive regeneration. By adding considerations for an after growth, the author proposes to make mere improvement fellings in the extended sense a permanent system. The other methods, the author contends, involve the removal of immature trees, which, although the end to be attained might justify it, is an unsilvicultural act. The improvement or transition felling leads gradually to selection method, but with this difference, that no attention is paid to the budget regulation of removing a certain number of trees or given volume; we should be treating the forest culturally without caring whether or not we were removing more than the possibility in any given year. All being done to secure a better forest, it is true economy.

The aim of regular methods of treatment is to obtain a regular succession of age classes whether in even-aged or in mixed crop, and a regular annual outturn the one connecting the other. A reference to market conditions is made showing that the equal annual sustained yield is no requirement of it.

The "possibility" by number or by volume can only be an approximation, and a poor one at that; the latter practically impossible in an Indian forest. The ascertainment of the increment is even more hazardous.

Not to fell trees that are mature is an unsilvicultural act, though perhaps not so bad as to fell immature trees, hence the sticking to the "possibility" may be uncanonical and unsilvicultural.

All of which points to the conclusion above noted, namely the adoption of a permanent improvement felling method. "Such a method will have one great advantage in India (and on this continent just the same!). The attempt to regenerate a forest by drastic opening of the cover to give light for a new, but at present non-existent crop, is, in India, fraught with great risk from the growth of grass and weeds, and from frost, while the habit of many of our species of dying back for a succession of years renders a thorough opening of the cover, and consequent drying

up of the soil especially dangerous before the seedlings have become established. Once established they generally respond well to the admission of light. With the proposed cultural method this risk would not occur and the seedlings would appear here and there and receive plenty of lateral shelter."

This unfettered cultural method is proposed only for species suitable for selection method.

A permanent method for treating selection forests without calculating the possibility. The Indian Forester. May, 1907, pp. 224-230.

Rotation and Diameter.

A very suggestive article by Blum discusses the desiderata for determining rotations in Saxony. While, as is well known, Saxony works with low rotations such as the soil rent theory justifies, the author points out that in the Saxon mountains mere general considerations bring the rotation to 80-85 years at most, for in that time these forests furnish the wood which is mostly desired in large quantities, namely, of a 9 to 10 inch middle diameter, which brings the best price. Coniferous wood over 14 inch diameter secures often a lower price than the 12 inch class. Moreover, there is to be considered deterioration in quality in those stands which are exposed to wind danger and to hoar frost and the difficulty and expense of transportation of stouter material from higher mountain ranges. These considerations are against higher rotations, especially as the mills can import the stouter sizes more cheaply from outside. The substitution of iron, and the preference of narrow floor boards has greatly changed the market for stout material. Good prices—10 cents per cubic foot—for small dimensions and poles prevail, while wood 20 years older brings hardly 2 cents more.

As Dr. Martin puts it: "The difference in the managerial aims of Saxony and Prussia is the consequence of the general rule, that the diameters of the final yield trees must be the larger, the farther the forest from the place of consumption." Saxony with its highly developed industries (like Massachusetts!), with its excellent system of roads and railroads marches in this respect on the extreme left, if the high rotations are to be considered as results of conservatism. The nearer the woodworking industry

locates near richly forested districts or these become more accessible by means of transportation, the more vanish the contradictions of the Saxon and other policies.

Zur Umtriebsfrage. Allgemeine Forst-und Jagdzeitung. July, 1907, pp. 239-240.

UTILIZATION, MARKET AND TECHNOLOGY.

Canada's Wood Market.

In a report of the German imperial forest expert at Montreal appears the following estimate of the prospects of Canada's wood export trade:

Of greatest importance for the wood trade of Canada are the forest conditions of its neighbor, the United States. For, on one hand, the latter still supply a part of the European demand, on the other hand they are themselves the best customers of Canada. The more the forests of the United States are exploited and reduced, the more will not only the States but Europe attempt to buy in Canada. For Germany this would mean only a change of market, if it could secure as desirable material, like the pitch pine (*P. palustris*), which is not the case. Hence there will be only slow progress in changing to that market.

It is different with England and the United States, the countries with well established trade relations. From decade to decade the export trade to these countries has grown in proportion to the depletion of the northern pineries. While Canada was desirous of finding markets for its wood products, she also tried to keep the wood industries in her own limits and to export manufactured materials. To this end various legislative measures were enacted. Export tariffs and restrictions have done good work. Mills were built in Canada by Americans, and in spite of tariffs lumber exports are increasing.

The United States and England are to-day the regulators of Canada's wood trade. If these do not buy, the market is depressed, if they are eager to buy, the prices in Canada rise.

Die Bedeutung Kanadas für den Holzhandel. Allgemeine Forst-und Jagdzeitung. June, 1907, p. 226.

Wood Consumption in Great Britain

The record year of wood imports into Great Britain was 1897 with 2,129,000 standards. The import for the year 1905 with 1,814,000 standards was at a minimum for the last decade, while the import for 1906 with 2,028,000 standards must be looked upon as normal. Up to the year 1901 it was Sweden that supplied the bulk of this import, but with that year "Russia's century" began, and Sweden is now considerably behind; while in 1897 the amounts were 601,800 standards for Sweden, and 536,000 standards for Russia, they were for 1906 494,300 and 702,300 respectively. In the meantime Norway showed an increase of 26,000 standards, Canada of 80,000, United States of 7,000, other countries 8,000, or, altogether an increase of about 214,000 standards over the total import of 1905, yet still 100,000 standards less than in 1897.

Trävarumarknaden. Skogsvärds Föreningens Tidskrift, 1907, pp. 53-55.

STATISTICS AND HISTORY.

Canadian Forest Policy.

An article by Dr. J. F. Clark shows wherein the usual methods adopted in Canada for the sale of government timber are wrong in principle and cannot fail to result in destructive methods of lumbering. A number of suggestions are made as to a change in policy, which, if adopted, would be certain to produce far more satisfactory results from the standpoint not only of the forest but of the government and of the lumberman as well. If the state offers its timber for sale under conditions which put a premium on forest destruction, the forest will surely be destroyed, all kinds of forestry propaganda to the contrary notwithstanding.

The principle of sale at public auction, after ample advertisement and opportunity for inspection, has been found most satisfactory and is coming into general use in Canada. This sale by public auction may take either one of two forms. (1) The stumpage due (*i. e.*, the price to be paid per thousand feet when the timber is cut) may be fixed in advance of the sale and bids may be asked for a *lump sum* or "bonus," which will represent the es-

timated value of the stumpage over and above the fixed stumpage dues; or (2) bids may be asked on the amount of *stumpage dues* to be paid per thousand feet board measure when the timber is cut.

The first or "bonus" system is in almost universal use and has in general proved iniquitous in its results. From the standpoint of the operator it is bad because (1) the payment of a portion of the stumpage cash-in-advance locks up a large amount of capital (or credit), which should normally be used in the development of the business. The effect of this is to limit the number of competitors to those having large capital and thus to reduce the prices realized. (2) Since not only the value of the stumpage but its amount must be carefully estimated by the purchaser, the cost of inspection preliminary to the sale is greatly increased, thus again limiting competition, to the detriment of the public. (3) Since estimates of the amount of standing timber are at best but approximations, a large speculative element is introduced and the purchaser never knows the cost of his raw material until the end of the operation.

From the standpoint of the province as seller, the "bonus" system is bad because (1) it is in reality a discounting of the future revenue-producing capacity of the forest, and introduces the undesirable element of irregularity in forest revenues. (2) It tends to limit the number of competitors in a position to bid at timber sales. (3) Since the amount of the "bonus" is based upon an estimate rather than upon an accurate scale, and since the scale frequently largely overruns the estimate, the inevitable result is large loss of revenue to the State. This loss is intensified through the steady rise of stumpage values, the increment by growth, and the development of a market for timber which, owing to its small size or unfavorable location, was not taken into consideration as having any value at the time of sale. (4) The whole tendency of a lump sum or bonus, with small stumpage dues, is toward clean-cutting, as contrasted with the opposite tendency where the amount to be paid per thousand feet is made the basis for the auction. (5) the "bonus" system leaves a constant temptation to carry the clean cutting system to the extent of leaving no merchantable timber for seed trees and thus places a premium on violation of the cutting regulations.

To remedy these evils it is recommended that the whole of the purchase price be paid in the form of so much per thousand feet, to be paid when the logs are cut, such price to be determined at public auction, with stipulations as to the cutting regulations to be followed. The lack of any effective measures to control the cutting on Canadian limits has brought about most deplorable conditions from the standpoint of the forester. It is not even to the interest of the lumberman to guard effectively against fire, since the greatest danger from this menace is on cut-over lands and young stands of coniferous timber, in which the lumberman is not financially interested.

A feature of all Canadian timber sales is the imposition of an annual land tax or "ground rent" per unit of area. British Columbia has made the imposition of a very high land tax a distinctive feature of her forest policy. It is shown that where the province grows the timber and merely sells the stumpage when it is mature, distinctly specifying what trees are to be cut and when they are to be cut, there can be no objection to the payment in this way of a small portion of the market value of the timber sold, and it may indeed serve a very useful purpose in preventing purchase for speculative purposes by others than bona fide operators. Where, however, the lumberman is the operator, the whole influence of a ground rent is toward early utilization and clean cutting, with the abandonment of the land after the destruction of the forest. The higher the ground rent the more inexorable is this tendency.

Sales far in advance of trade requirements are deprecated, and the setting of a time limit for the removal of timber recommended. A sale policy is advocated which includes the making of preliminary estimates by the government of the amount of timber to be sold, proper advertisement in advance of sale, and the adoption and enforcement of cutting regulations to secure the protection and reproduction of the forest. It will be noted that practically all of the changes advocated are in substance already in effect in the sales of timber made upon the national forests in the United States.

Forest Revenues and Forest Conservation. Canadian Forestry Journal. March, 1907, pp. 19-30.

Statistics of Hesse.

Forestry in Hesse is carried on very intensively on the small forest area which in 1900, according to official statistics, comprised 597,300 acres, or about ½ acre per capita. Ownership is nearly evenly distributed between state, corporations and private, namely, about in proportion of 31:38:31. In 1901 and 1902 there are 92 forest-fires recorded, of which 26 and 28 per cent. were caused by railroads.

The results of a progressive improvement in conditions is indicated by the administration of the grand duke's personal property. Here the timberwood per cent. rose from 7.8 in 1861 to 22.9 in 1902 on a cut in the latter year of 84.3 cubic feet per acre, producing a net income per cubic foot of 5 cents (a little less than 11 cents for workwood, and less than 3 cents for fuelwood) and $4 per acre as against $2.40 in 1861. For planting purposes the expenditure is only about 52 cents per acre and for roads 36 cents.

In the larger corporation forests (over 125 acres) the cut averaged only 7.5% less than in the domainial property, namely 78 cubic feet. In the state forests, with round 10,000 acres, the increase in labor wages in 1902 of 20 per cent. for logs and 5 per cent. for fuelwood caused a reduction in gross money returns of 13 per cent. from those of 1901, the average of the two years being still $9 per acre.

Mitteilungen aus der Forst-und Kameralverwaltung für das Jahr 1906. Allgemeine Forst-und Jagdzeitung. May, 1907, pp. 171-178.

Labor Cost in Prussia.

The Prussian forest department, with its nearly 7,000,000 acres in 1905, employed 156,971 laborers on 10,287,180 days, wages being in summer (9.9 hours) for men 37 cents in the average, 65 cents maximum, for women 20 cents and 39 cents respectively; in winter (8.1 hours) for men 29 and 62 cents; for women 16 and 35 cents. In piecework men earned as much as 81 cents in summer and 71 cents in winter.

The administration also paid nearly $24,000 to the insurance fund for their laborers.

Nachweisung über die von der Preussischen Staatsforstverwaltung beschäftigten Arbeiter, etc. Allgemeine Forst-und Jagdzeitung. May, 1907, pp. 187-188.

Early History in England.

The following brief note on forest conditions in England by Dr. Hausrath may be of interest: Until the beginning of the fourteenth century, the forests of England were well preserved by the kings of England, who used them as hunting parks. But with the accession of Edward III in 1327 their destruction began and continued steadily, until now less than 4% is forested. The orginal forest area is uncertain; the dominant tree was oak, next came beech; conifers are not mentioned in the records, except fir, yew and juniper, which only appear in single instances. The growing of hazel nuts for game cover was one of the forester's duties. As early as the thirteenth century the English forests formed quite an important source of income. Sales of wood material for building and firewood took place regularly. The use of underbrush and fallen trees was generally permitted to the settlers. In 1260, the average tree fit for use or firewood was valued at 12 pence, although it varied from 3 pence up to 2 shillings for stout beech, which, allowing for change in the value of money, is equivalent to about $3 of our present currency, about 4 to 5 cents per cubic foot. Two other methods of obtaining income from the forests were employed. Those appointed to the office of guarding the forest were obliged to pay for the privilege; they in turn squeezed money out of the peasants to recoup themselves. Fines were laid for offences against the forest and for hunting. The fine for felling a green oak in 1255 was, on the average 1½ shillings. The owners of forest land were allowed to use the underbrush and small material, but not to fell green oak, under penalty of fine of several pounds. This system, of course, required a large number of officers. The highest were the Justices of Forest, whose business it was to investigate and punish offences against the forest. The real forest officers were the Wardens, the executive officers of the king. Under these were the forest guards. Private owners of forest land were also obliged to employ forest guards, and if a royal officer discovered an offence against the forest before the private guard, the forest was forfeited to the crown.

Aus Englands Forst-und Jagdgeschichte. Allgemeine Forst-u. Jagdzeitung. June, 1907, pp. 189-193.

MISCELLANEOUS.

Educational Question.

At this time when forest schools multiply in the United States at a dangerous rate, it is of interest to come to a conception of standards in forestry education. In this connection the discussions in an entirely different sphere, namely, at the sessions of the German Forstwirtschaftsrath, may be suggestive. One of the points of difference in opinion we shall probably never be called upon to consider, namely, the question of whether special academies or universities should undertake the higher teaching of forestry.

The academy at Mont Alto, Pennsylvania, is, to be sure, making attempts to get away from its orginal praiseworthy plan of educating forest rangers, and may give rise to controversies on this point.

In Germany special schools have for a hundred years been in existence and it is probably only the momentum of their existence which has prevented their transfer to the universities. Only Munich, Giessen and Tubingen have forestry faculties.

The following theses were formulated by Dr. Endres for the discussion, and appear to represent the sense of the majority:

1. Isolated technical schools cannot any more be considered as fit educational institutions.

2. Since the practical activity of a forest manager consists to at least fifty per cent. in purely administrative work which requires thorough knowledge of political economy, administrative and judicial subjects, for this reason alone connection with a university is necessary. Other mental, social and educational advantages are also cited.

3. The time of studies at the university should be four years (double the time of our present forestry schools).

4. The usefulness of a so-called practical institution before the university studies is in no proportion to the expenditure of time for it.

5. The connection between agricultural and forest schools can only impede the latter and is objectional.

6. It is most desirable that the number of higher forest schools for Germany be restricted to three or four.

Unsre Forst-Akademien. Allgemeine Forst-und Jagdzeitung. July, 1907, pp. 249-251.

NEWS AND NOTES.

E. A. Sterling, *In Charge.*

On May 30th one of the best known foresters among English speaking people, Sir Dietrich Brandis, died at Bonn, Germany. His fame was made through the successful introduction of forestry principles into India, and the original organization of the Indian Forest Department. Born and educated in Germany, a pupil of Gustave Heyer at Giessen, hence thoroughly versed in forestry he succeeded in grasping the needs of entirely different conditions in India from the start, when over half a century ago he was called to the sperintendency of the teak forests of Pegu. He was, to be sure, loyally and vigorously supported by Lord Dalhousie's government, and in 1864 became the first Inspector General of Forests to the Government of India. In a different spirit from the know-nothing attitude that sometimes has animated American forest reformers, Mr. Eardley Wilmot writes, "To him and to his successors and pupils, Messrs. Schlich and Ribbentrop (also two Germans) is due primarily the credit for the creation and organization of the forest department and for the introduction of methods of management adapted from the best European schools to suit the various circumstances for the vast forests of India." His last work, a large manual on Indian Trees, only lately published, was the result of his leisure since 1883, when he had retired to Bonn, without however losing connection with the department of his creation.

Probably no other gathering of industrial interests has been so assiduously and broadly advertised as the Fifteenth National Irrigation Congress to be held in Sacramento, California, in September. Forestry also is to be made a special feature, especially in the Interstate Exposition which will be a part of the proceedings. Among the prizes and trophies to be offered for special exhibits the Diamond Watch Company and the Pacific Hardware Company have each presented one for the best collective State exhibit of forest products, but the most suggestive trophy is

offered by the California Wine Association, which is to be for a suitable substitute for oak staves, accentuating the growing scarcity of the supply which is coupled by a constant and rapidly increasing demand.

A committee of the American Society for Testing Materials has made its final report at the tenth annual meeting this year on standard specifications for the grading of structural timbers, including the definition of standard defects, standard names for structural timbers, and standard specifications for bridge and trestle timbers.

The definitions of standard defects, modified as above, are as follows:

Measurements which refer to the diameter of knots or holes should be considered as referring to the mean or average diameter.

1. *Sound Knot.*—A sound knot is one which is solid across its face and which is as hard as the wood surrounding it; it may be either red or black, and is so fixed by growth or position that it will retain its place in the piece.

2. *Loose Knot.*—A loose knot is one not firmly held in place by growth or position.

3. *Pith Knot.*—A pith knot is a sound knot with a pith hole not more than ¼ inch in diameter in the center.

4. *Encased Knot.*—An encased knot is one which is surrounded wholly or in part by bark or pitch. Where the encasement is less than ⅛ of an inch in width on both sides, not exceeding one-half the circumference of the knot, it shall be considered a sound knot.

5. *Rotten Knot.*—A rotten knot is one not as hard as the wood it is in.

6. *Pin Knot.*—A pin knot is a sound knot not over ½ inch in diameter.

7. *Standard Knot.*—A standard knot is a sound knot not over 1½ inches in diameter.

8. *Large Knot.*—A large knot is a sound knot, more than 1½ inches in diameter.

9. *Round Knot.*—A round knot is one which is oval or circular in form.

10. *Spike Knot.*—A spike knot is one sawn in a lengthwise direction; the mean or average width shall be considered in measuring these knots.

11. *Pitch Pockets.*—Pitch pockets are openings between the grain of the wood containing more or less pitch or bark. These shall be classified as *small, standard* and *large* pitch pockets.

(*a*) *Small Pitch Pocket.*—A small pitch pocket is one not over $\frac{1}{8}$ of an inch wide.

(*b*) *Standard Pitch Pocket.*—A standard pitch pocket is one not over $\frac{3}{8}$ of an inch wide, or 3 inches in length.

(*c*) *Large Pitch Pocket.*—A large pitch pocket is one over $\frac{3}{8}$ of an inch wide, or over 3 inches in length.

12. *Pitch Streak.*—A pitch streak is a well-defined accumulation of pitch at one point in the piece. When not sufficient to develop a well-defined streak, or where the fiber between grains, that is, the coarse-grained fiber, usually termed "Spring Wood," is not saturated with pitch, it shall not be considered a defect.

13. *Wane.*—Wane is bark, or the lack of wood from any cause, on edges of timbers.

14. *Shakes.*—Shakes are splits or checks in timber which usually cause a separation of the wood between annual rings.

15. *Rot, Dote* and *Red Heart.*—Any form of decay which may be evident either as a dark red discoloration not found in the sound wood, or the presence of white or red rotten spots, shall be considered as a defect.

16. *Ring Shake.*—An opening between the annual rings.

17. *Through Shake.*—A shake which extends between two faces of a timber.

The following trade names are those now recommended by Committee Q:

1. *Southern Yellow Pine.*—Under this heading two classes of timber are used, (*a*) Longleaf Pine, (*b*) Shortleaf Pine.

It is undertsood that these two terms are descriptive of quality, rather than of botanical species. Thus, shortleaf pine would cover such species as are now known as North Carolina pine, loblolly pine, and shortleaf pine. "Longleaf Pine" is descriptive of quality, and if Cuban, shortleaf, or loblolly pine is grown under such conditions that it produces a large percentage of hard summer wood, so as to be equivalent to the wood produced by the

true longleaf, it would be covered by the term "Longleaf Pine."

2. *Douglas Fir.*—The term "Douglas Fir" to cover the timber known likewise as yellow fir, red fir, western fir, Washington fir, Oregon or Puget Sound fir or pine, northwest and west coast fir.

3. *Norway Pine,* to cover what is known as "Red Pine."

4. *Hemlock,* to cover Southern or Eastern hemlock; that is, hemlock from all States east of and including Minnesota.

5. *Western Hemlock,* to cover hemlock from the Pacific coast.

6. *Spruce,* to cover Eastern spruce; that is, the spruce timber coming from points east of Minnesota.

7. *Western Spruce,* to cover the spruce timber from the Pacific coast.

8. *White Pine,* to cover the timber which has hitherto been known as white pine, from Maine, Michigan, Wisconsin and Minnesota.

9. *Idaho White Pine,* the variety of white pine from western Montana, northern Idaho, and eastern Washington.

10. *Western Pine,* to cover the timber sold as white pine coming from Arizona, California, New Mexico, Colorado, Oregon and Washington. This is the timber sometimes known as "Western Yellow Pine," or "Ponderosa Pine," or "California White Pine," or "Western White Pine."

11. *Western Larch,* to cover the species of larch or tamarack from the Rocky Mountain and Pacific coast regions.

12. *Tamarack,* to cover the timber known as "Tamarack," or "Eastern Tamarack," from States east of and including Minnesota.

13. *Redwood,* to include the California wood usually known by that name.

The standard specifications for bridge and trestle timbers are as follows, to be applied to solid members and not to composite members:

General Requirements.

Except as noted all timber shall be cut from sound trees and sawed standard size; close grained and solid; free from defects such as injurious ring shakes and crooked grain; unsound knots; knots in groups; decay; large pitch pockets, or other defects that will materially impair its strength.

Standard Size of Sawed Timber.—Rough timbers when sawed to standard size, shall mean that they shall not be over $\frac{1}{4}$ in. scant from actual size specified. For instance, a 12 in. x 12 in. shall measure not less than $11\frac{3}{4}$ in. x $11\frac{3}{4}$ in.

Standard Dressing of Sawed Timbers.—Standard dressing means that not more than $\frac{1}{4}$ in. shall be allowed for dressing each surface. For instance, a 12 in. x 12 in. shall after dressing four sides, not measure less than $11\frac{1}{2}$ in. x $11\frac{1}{2}$ in.

Stringers.

No. 1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show not less than 80 per cent. of heart on each of the four sides, measured across the sides anywhere in the length of the piece; loose knots, or knots greater than $1\frac{1}{2}$ in. in diameter, will not be permitted at points within 4 inches of the edges of the piece.

No. 2. *Longleaf Yellow Pine, Shortleaf Pine, Douglas Fir, and Western Hemlock.*—Shall be square edged, except it may have 1 in. wane on one corner. Knots must not exceed in their largest diameter $\frac{1}{4}$ the width of the face of the stick in which they occur. Ring shakes extending not over $\frac{1}{8}$ of the length of the piece are admissible.

Caps and Sills.

No. 1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show 85 per cent. heart on each of the four sides, measured across the sides anywhere in the length of the piece; to be free from knots over $2\frac{1}{2}$ in. in diameter; knots must not be in groups.

No. 2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir and Western Hemlock.*—Shall be square edged, except it may have 1 in. wane on one corner, or $\frac{1}{2}$ in. wane on two corners. Knots must not exceed in their largest diameter $\frac{1}{4}$ the width of the face of the stick in which they occur. Ring shakes extending not over $\frac{1}{8}$ the length of the piece are admissible.

Posts.

No. 1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show not less than 75 per cent. heart, measured across the face anywhere on the length of the piece; to be free from knots over $2\frac{1}{2}$ in. in diameter, and must not be in groups.

No. 2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir and Western Hemlock.*—Shall be square edged, except it may have 1 in. wane on one corner, or $\frac{1}{2}$ in. wane on two corners. Knots must not exceed, in their largest diameter, $\frac{1}{4}$ the width of the face of the stick in which they occur. Ring shakes shall not extend over $\frac{1}{8}$ of the length of the piece.

Longitudinal Struts or Girts.

No. 1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show one face all heart; the other face and two sides shall show not less than 85 per cent. heart, measured across the face or side anywhere in the piece; to be free from knots $1\frac{1}{2}$ in. in diameter and over.

No. 2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir, and Western Hemlock.*—Shall be square edged and sound; to be free from knots $1\frac{1}{2}$ in. in diameter and over.

Longitudinal X-Braces, Sash Braces and Sway Braces.

No. 1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show not less than 80 per cent. heart on two faces and four square edges; to be free from knots over $1\frac{1}{2}$ in. in diameter.

No. 2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir, and Western Hemlock.*—Shall be square edged and sound; to be free from knots $2\frac{1}{2}$ in. in diameter and over.

Mr. L. D. Van Rensselaer, of Ithaca, N. Y., advertises insurance against fire for standing timber and for cut wood lying in the forest.

In Michigan a bill was passed by the Legislature, withdrawing 40,000 acres of Agricultural College lands from sale, with a view of ultimately turning them into a forest reservation. The Senate also passed a bill providing for a commission to investigate the question of reforesting, but we are not informed that it has become a law.

The State of Washington has entered the number of States providing educational facilities for forestry in connection with the College of Agriculture, Prof. W. S. Thornber in charge.

The State Forester of Maryland has begun a detailed study of the forest resources of the State by counties. The work done by the Forest Service of the U. S. Department of Agriculture in several counties is being revised and greatly extended to give accurate and complete reports. In addition to this, two counties not heretofore studied have been taken up in detail and will be completed before the end of the season. After August 15th the State Forester will co-operate with the Forest Service in examining lands in western Maryland for the proposed Appalachian National Forest.

In connection with the plans of the Santa Fe Railroad to propagate eucalyptus on a large scale in California, E. O. Faulkner, manager, Tie and Timber Department, will go to Australia about the middle of September to study the various species of eucalyptus in their native habitat. It is understood that species suitable for railroad cross-ties will be planted in southern California; so the question of rapid-growing species suitable to the soil and climate conditions of the land acquired, and which will take treatment readily, is to be carefully investigated. This recognition of eucalyptus by such a commercial organization should give added impetus to the planting of this tree where conditions are favorable.

That the policy of wood preservation by the Northern Pacific Railroad is to be put on a more permanent basis is evident from an official circular to the effect that Mr. Andrew Gibson was appointed Superintendent of Timber Preservation and Tie Treating Plants, on August 1. The Company now operates treating plants at Brainerd, Minn., and Paradise, Mont.

The following changes in the teaching staffs of the Forestry Departments in several western colleges have been made: Prof. F. G. Miller, of the University of Nebraska goes to the University of Washington, at Walla Walla, his place at Lincoln being taken by F. J. Phillips, of the Forest Service; while E. O. Siecke, also of the Forest Service, is to teach in a new school of Forestry established in connection with the State College of Washington, at Pullman. Professor Phillips graduated in forestry from the University of Michigan in 1906 and Professor Siecke did like-

wise from the Iowa State College of Agriculture and the Mechanic Arts the same year. Both have had wide experience in the extension of the Forest Service. Prof. H. P. Baker has left the Iowa State College of Agriculture to organize the Department of Forestry which Dr. Fernow instituted at the Pennsylvania State College.

The registration at the Yale Summer School of Forestry at Milford, Pa., has this year been exceptionally large. It will be recalled that Yale conducts two courses in connection with its summer school: first, the regular summer term which is required of the Junior Class; second, a short course designed for prospective rangers, woods foremen, and others who wish a short general course of forestry. This year sixteen men are taking the short course and fifty are enrolled in the long course.

The summer work is in charge of Prof. H. S. Graves, who has associated with him this year in the technical forestry work Prof. H. H. Chapman, Dr. A. H. Graves and Mr. N. C. Brown, and in the work of surveying Prof. J. C. Tracy, Mr. C. S. Farnham and Prof. Wheeler.

Mr. H. H. Chapman has recently been promoted from the position of instructor in Forestry to an assistant professorship.

Prof. J. W. Toumey is inspecting, for the Forest Service, the work of planting on the national forests. Mr. R. C. Bryant, who has charge of the work in lumbering at Yale, is travelling in the South inspecting the plants of different large manufacturers of lumber. Mr. R. C. Hawley, instructor in Forestry, is working during this summer for the Bureau of Corporations in connection with their investigation of the amount of standing timber in the country.

The fall term of the Forest School opens October 1st.

S. B. Detwiler, who received his training at Yale and University of Minnesota, has left the Forest Service to become assistant to Prof. Green at the University of Minnesota.

John Foley left the Forest Service to become assistant to E. A. Sterling, forester to the Pennsylvania Railroad Company. Max Rothkugel has re-entered the Forest Service.

Mr. Robert C. Rosenbluth (Yale, '07) after entering the Forest Service July 1st resigned at the end of the month to accept a similar position in the Philippine Bureau of Forestry. Mr. Rosenbluth sailed early in August to enter upon his duties in the islands.

Dr. W. C. Geer (Cornell, '02) severed his connection with the Forest Service August 1st to accept the position of superintendent with the B. F. Goodrich Rubber Company at Akron, Ohio. During the past year Dr. Geer has made an exhaustive study of the destructive distillation of wood.

The legislature of Massachusetts this year improved upon its forest legislation by consolidating and re-organizing the forest warden system and making the appointment of forest wardens (formerly forest fire wardens) subject to approval by the State Forester. The measures for preventing forest fires due to locomotive sparks are also improved by enforcing the use of spark arresters and burning over right-of-way for 200 feet each side as well as cleaning up unimproved land adjoining. It also provides for a *trained forester who has had a technical education* as State Forester, with a salary of $3,000 per annum.

The Dominion Government of Canada in its Department of the Interior has begun to publish in elegant style a preliminary edition of a set of maps of the Provinces of Manitoba, Saskatchewan and Alberta and of the railway belt of British Columbia on a scale of 12½ and 7.89 miles to the inch respectively. This scale permits the showing by color of character of ownership down to quarter sections, namely, homesteads patented, unpatented and entered, Indian Reserves, Forest Reservations, Timber Berths, and Special Grants. The information is corrected to July 1, 1907. In addition the character of the country, whether prairie, park country, chiefly wooded or timbered is indicated.

A broken line in gold, limits these various types of country of course only approximately. It would appear that while outside of British Columbia there is little timber for commercial use, the country is nevertheless largely woodland, where wood for local use should be husbanded, for Canada is a country practically

without coal. Just 12 forest reservations, mostly small ones, are located in various parts of the prairie country, besides 8 larger ones in the Railway Belt. Altogether there appears to be much more settled country in these sections than one is accustomed to think and the country open to entry is mostly away from rivers or rail.

That forest planting is part but not all that enters into the practice of forestry by private corporations is an axiom of the profession. Despite the propaganda, for some years past the unfortunate fact remains that little reliable data is available on the cost of private planting in the East. Since the utilization of waste lands by planting is part of the forest policy of the Pennsylvania Railroad, figures on the cost of the work done this spring may be interesting and suggestive.

The planting was done during April and May on ten sites in three localities between Harrisburg and Altoona. The seedlings used were 1 to 3 years old, purchased for $5.25 per M. Where Italians planted the trees 6′ x 6′ in holes prepared with mattocks, the cost was $5.12 per 1,000. With American labor and the trees planted 4′ x 6′ apart in furrows 5′ apart, the cost was $7.85 per 1,000 in one place and $4.82 in another. The greater expense in the one case was due to clearing brush and resetting fences. In all 448,226 seedlings were planted at an average expense of $6.04 per M. If their purchase price were included the set-out trees cost $11.29 per M. or $15.93 per acre. The species handled are shown in the following table:

Species	*Number of seedlings planted*
Red Oak,	252,154
Black Locust,	175,716
European Larch,	6,970
Pin Oak,	4,570
Scotch Pine,	3,500
Tamarack,	3,000
Chestnut,	2,316
Total,	448,226

Circular No. 23, issued from the office of the Second Vice-President of the Atchison, Topeka & Santa Fe Railway System, under date of July 24th, 1907, states that: "Mr. Hermann von Schrenk is hereby appointed Consulting Timber Engineer, with headquarters at St. Louis, Mo. Effective August 1, 1907. A circular letter dated July 1st gives the further information that Dr. Von Schrenk is to be one of a firm of Consulting Timber Engineers. His associates being E. B. Fulks, and Alfred L. Kammerer. This follows Dr. Von Schrenk's resignation as Pathologist in charge of investigatons of timber diseases and methods for preventing the same, in the United States Department of Agriculture. This firm has established a technical laboratory and consulting office at St. Louis, devoted to the prosecution of investigations into the uses of timber, and are prepared to carry on investigations and make reports on all problems dealing with the utilization of timber, the closer adaption of all kinds of woods to special uses, and determination as to the kind and value of various preservative processes.

ERRATA IN VOL. V, NO. 2.

The following serious errata have, after proofreading, crept into tables and plates accompanying the article on The Sprout Forests of the Housatonic Valley, which readers are asked kindly to correct.

Page 125, Plate II, Fig. 3. In the title change "at right" to "at base."

Page 129, Table II. In fifth column, drop "25" to line below In eleventh column, reverse "17" and "18". In seventeenth column, change "4" to "3".

Page 134, Plate III. Interchange titles, and insert in title for lower figure, "two Chestnuts" after "Hickories."

Pages, 140, 142, 144. In the title of these diagrams, interchange readings so that dominant seedling trees are represented by heavy dots, suppressed sprouts by light unbroken line.

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AN EFFECTIVE SCREEN FOR NURSERIES.

Screens for shade in evergreen seedling work, form one of the factors in adding to the cost of plants. A simple and cheap form of screen being used in the Government nurseries at the Agricultural College, Guelph, Ontario, is shown in the illustration (frontispiece).

This screen is made in a machine which was constructed for the manufacture of picket fence. A four foot lath is used and is woven with six strands of wire as shown in the cut. The screen was made and delivered for seventy cents a rod. A comparison with the screens previously used, might be of interest, taking for granted that the supports are the same in both cases. The old screen was made by nailing lath on a frame 4 ft. x 10 ft. requiring six screens for a sixty foot bed. The material (lath, strips and nails) for the sixty foot bed would cost about $3.75, without the labor. The woven roll ready to place on supports costs about $2.55 per sixty feet.

The advantages in handling these screens are obvious. In removing or replacing the screen it takes less time to handle this roll and it can be so placed that it will not interfere with weeding or other operations. The screens in the illustration have been in use three seasons, and appear as though they would give service for several more years.

E. J. Zavitz.

ECONOMIC THINNING OF WHITE PINE.

Low prices for chestnut cordwood have so far prevented any widespread interest in improvement thinnings in the New England woodlot, and enthusiasm in forestry has therefore centered about planting. To the owner of a white pine lot, however, thinnings may be made a source of revenue not to be despised. Such thinnings from an eight acre lot in Connecticut recently brought the owners a net income of $354.55—or $44.32 per acre.

This grove of pines is situated on the boundary between the towns of Windsor and Bloomfield, Connecticut, about three miles from the former village, and ten miles from Hartford. It is owned by the Loomis Institute, an educational establishment anxious to preserve it, not only for financial and æsthetic purposes, but to maintain a place for the study of applied forestry by the students. The average age of the trees is fifty years, although there are groups considerably older from which the others evidently seeded. The land was originally under cultivation, but is a light sand soil characteristic of the region, largely abandoned during the last century, but now quite extensively used for tobacco by means of heavy fertilization.

The many pine groves throughout Southern New England have suffered severely from a cause which is still unsettled. Professor Stone, of Amherst, believes the death of large numbers of pines throughout New England to be due to a winter injury to the roots. Whether this is the primary injury or not remains to be proved, but certainly the roots of these trees have suffered extensively. Windfalls have been very numerous, and in every case, even of trees apparently in good health, the roots were found to be all rotted off, nothing remaining to hold the trees. In some of the trees the foliage has turned brown and died, which may point to fungus disease or injury by insects. An examination by Dr. Britton, State Entomologist, showed that while some were infested with a number of borers, these usually confined their attention to the dead or dying parts of the trunk and were not species liable to directly cause such injury.

The insects found were identified by Dr. Hopkins as *Tomicus pini; Pityogenes sp.; Pytho Americanus,* and *Pytho niger.*

An examination of the roots by Dr. Clinton, Botanist of the Experiment Station, showed that the mycelium of some hymenomycetous fungus was present in the dead roots and to some extent on the surface of the living. This fungus was not determined, as its fruiting stage was not present at the time of the examination in March. It is, of course, possible that the fungus was present merely as a saprophyte.

The high mortality in this grove was well shown by survey plots indicating that 15% of the standing trees were dead. This is not the whole story, however, as dead trees have been cut out from time to time for æsthetic reasons and enumeration showed that the average number of trees per acre alive and dead was 292. Professor Graves in his "Forest Mensuration" shows for Scotch Pine that the normal number of trees in stands fifty years old are: on Quality I, 464 trees; Quality III, 848 trees; Quality V, 1588; and Spring in his bulletin No. 63 of the U. S. Forest Service shows that the average number of trees in New England white pine groves fifty years old is 400, or 108 more than the grove in question. There is a white pine plantation seventy years old in northeastern Connecticut with 524 trees per acre.

Besides the dead trees which were mostly of diameters under twelve inches, there were a great many partially or nearly suppressed trees with very slender stems and almost no tops. The unevenness of the stand, which might have been avoided by early thinnings, had resulted in many large openings and corresponding dense spots. The diameters of the live trees ranged from six to eighteen inches with little difference between the trees of small and large diameters.

This grove has escaped damage from fire and the result is a most encouraging reproduction of white pine. While many lumbermen of New England are becoming interested in forest planting, they overlook entirely the possibility of perpetuating forests by natural reproduction. The advanced groups of pine seedlings in all the openings of this grove and the innumerable little seedlings scattered throughout all point to the possibility of harvesting the mature timber in such a way as to get complete reforestation.

It was determined to make a light thinning for the three-fold

purpose of improving the growth of the best trees while utilizing the dead and inferior trees and for assisting the reproduction already started. The thinning was primarily "Improvement" and on account of the great danger from windfall was made conservatively, many trees being left, which under other conditions would be cut. All dead and dying timber was cut and all suppressed trees ,and where there was not too much danger from windfall, intermediate trees interfering with the development of better individuals. It is hoped that the increased opportunity for crown development will result in growth of new roots and that the stand will become more wind firm before it is time for another trimming in six or eight years.

All trees to be removed were marked twice: once at breast height to be plainly seen, and once on the roots for checking up after the work. The marking required about two days' labor.

The following table shows the stand of one representative quarter acre. The volume in board feet are obtained from Mr. Hawley's Volume Table published in an annual report of the State Forester of Massachusetts:

Survey of One Quarter Acre.

Diam. Breast High Inches	No. of Trees Left	Vol. of Trees Left Board Ft.	No. of Trees Dead	Vol. of Trees Dead Board Ft.	No. of Others to Be cut	Vol. of Others to Be cut Board Ft.
6			3	90	2	60
7			6	300	6	300
8	2	130	2	130	3	195
9	7	700			4	400
10	7	770			1	110
11	6	840	2	280		
12	7	1,155	1	165		
13	6	1,140				
14	5	1,075			1	215
15	4	980				
16	3	810			1	270
17	2	600				
18						
19	2	800				
Total,	51	9,000	14	965	18	1,550

Average Per Acre.

	Number	Volume B. M.
Trees to be left,	204	36,000
Dead trees,	56	3,860
Other trees to be cut,	72	6,200
Total,	332	46,000

	Number	Volume B. M.
Trees alive,	276	42,200
Per cent. of live trees,	83	91
Trees to be cut,	128	10,060
Per cent. of trees to be cut,	37	21

In the above table, the volumes of the dead trees are given in board feet just as the others, but as a matter of fact, only a few of the dead trees were sound enough to be sawed into lumber.

Three quarter acre plots similar to the above were surveyed in the grove and the results are given in the following table:

Surveys of Three One Quarter Acre Plots.

No. of Plot	Trees Left		Dead Trees		Other Trees to Be Cut	
	No.	Vol. B. M.	No.	Vol. B. M.	No.	Vol. B. M.
1	51	9,000	14	965	18	1,550
2	42	8,250	8	630	9	770
3	47	6,050	10	1,305	20	1,085
Sum,	140	23,300	32	2,900	47	3,405
Av. per ¼ acre,	47	7,767	11	966	16	1,135
Av. per acre,	188	31,068	44	3,864	64	4,540

Total volume to be cut per acre, ... 8,404 feet B. M.
Total volume to be cut from 8 acres, ..67,232 feet B. M.

After the trees were marked, the various lumbermen of the region were asked to bid on the stumpage and inquiries were made as to letting out contracts for the cutting, hauling and sawing, and the final value of the finished lumber. While it seemed possible that a greater profit might be realized by doing the lumbering themselves, the trustees of the Institute were too busy to undertake the supervision, and the stumpage was therefore sold to a lumberman of Windsor who set up a portable mill on the lot. He paid six dollars per thousand for lumber and one dollar and a quarter for cordwood, cutting all dead trees and tops into wood. The work was done carefully, only one unmarked tree being injured in the felling. After the cutting a few more trees were marked and cut, amounting perhaps to two thousand feet, board measure. The lumberman's figures of the cut were accepted. These were:

51,800 feet @ $6.00,		$310 80
35 cords @ 1.25,		43 75
		$354 55

Allowing five hundred feet of lumber as the equivalent of one cord of wood, the thirty-five cords equal 17,500 feet. Therefore the total volume cut was 69,300 feet, almost exactly the estimated amount plus the volume of the few trees marked later. Besides illustrating the feasibility of improvement thinnings in white pine this grove shows very well what may be expected in the way of financial results from such pine forests in Southern New England. The stand before cutting contained in all 40,000 feet per acre. It had therefore, grown an average of 800 feet per acre per annum, worth at $6.00—$4.80. The land around it covered with brush is worth about $8.00 an acre. Undoubtedly if it has produced 800 feet without management, it can be made to produce 1,000 feet by a little care, and will then yield its annual revenue of $6.00 per acre, and as prices increase the revenue will be larger. There is every reason to expect that by judicial cutting this forest can be made to produce such a revenue perpetually.

In the case under consideration the money received from the thinnings was expended in burning tops, clearing out brush to favor reproduction, and in planting an adjoining piece of waste land to pine.

AUSTIN F. HAWES.

TAXATION OF WOODLANDS.*

The subject of the taxation of woodlands has been for some time urged as one which is of importance to the development of forestry practices in the handling of timberlands. And the discussions have charged the absence of such practices to excessive taxation, which forces the lumberman to be satisfied with a mere rapid exploitation instead of management for future crops.

Two main questions arise when discussing forest taxation: First, What points must be considered in securing the assessment of an equitable tax? Second, Will such equitable taxation or else tax reduction or exemption secure the application of forestry practice to timberlands?

The first thing to recognize is that very widely differing kinds of property, of widely different value, are liable to be taxed as woodland.

There are at least three classes of woodland: the virgin uncut marketable timber; the cut-over lands with promising growth of value; the stumplands without value, unless through special effort. And a fourth class may be added, as yet little developed, namely, of artificial plantations.

That these three or four classes deserve different treatment will be readily admitted.

What are the points regarding the first class, the uncut timberlands? It is property of high value, immediately available by mere exploitation—by destructive lumbering. It is also capable of being made a continuous revenue producer, by conservative lumbering. How does the tax assessor approach it?

In all political questions—and taxation is a political question in the broadest sense—principle and expediency *i. e.* theoretical and practical considerations are involved, and, especially in a community still in the pioneering stage, the latter considerations, those of expediency, will often outweigh the force of acknowledged correct principles. The argument that the timber land owner, being the richer man, possesses greater tax-paying faculty, *i. e.* can afford to pay a relatively higher tax rate than the poorer

*Presented at the Conference of the Lake States at Saginaw, Nov. 1907.

settler, is sufficient to justify the neglect of the principle of justice and equal treatment. The argument that the settler has in view permanency, continuity in creation of values from the soil, continuous improvement, that all his work tends to form a permanent asset for future assessment and taxation, while the lumberman has in view merely exploitation and the removal of values which he has not created—this argument, at least in a pioneering community, very naturally and properly weighs with the tax assessor so as to set the principle of justice at naught. He naturally favors the farmer, and "sticks" the logger, whose greater wealth enables him to contribute at a higher rate towards the development of the country, the county, the township. It is human nature to do so, and human nature forms an unavoidable third factor in solving political questions. While the tax assessor maintains equality in the rate, he considers inequality in valuation justifiable according to tax faculty; effectiveness rather than justice is his aim. He also takes into consideration the attitude of the owner. It is this attitude towards his property that distinguishes settler and lumberman, and that seems to explain and to justify a seemingly unjust distribution of the burdens of taxation. If it could be shown that the timberland owner had the intention of making his property the basis of a permanent enterprise, the case would perhaps be looked at differently, but until such *bona fide* change of attitude can be shown, I fear, practical considerations will favor continuance of present practice. In this connection a few questions may be formulated, which should be considered as pertinent from the practical point of view.

1. Does the lumberman as a rule buy land, or does he buy timber? That is, does he consider in his purchase the soil and its capacity for production, or only the product?

2. Is any lumberman known to have bought timber for any other purpose than exploitation or speculation?

3. Does not every lumberman with business capacity, in buying timber, anticipate the tax assessment and discount it in his price?

4. Has actually any lumberman been induced to cut his timber in order to avoid the tax rate, or are not other motives than excessive taxation invariably or usually the reason, or at least more potent reason, for his removal of it?

5. Has any lumberman become poorer by risking the higher tax rate, when compared with the settler and his lower tax rate or assessment?

6. Does not the lumberman shift the tax on the consumer of his goods, wholly or in part, the tax being counted as part of the cost of production?

7. Does not, in view of the rapidly increasing stumpage value, the tax rate appear to be a relatively small matter?

In Ontario, at least as far as I can find out, there is as a rule no complaint on the part of the timberland owners on this score of iniquitous tax. On the contrary, although in a given case, which lately came to my knowledge, the per acre assessment is not changed after the timber is cut, the owner is satisfied, and unwilling to clamor for justice, because in comparison with the stumpage price and possible future values of timber and land the average assessment of cut and uncut lands is fair enough.

Timberlands have been, and are still, among the most profitable properties, and these more than any other properties increase in value by "unearned increments." Even the principle of justice seems to be satisfied by charging profitable properties with higher tax assessment than unprofitable ones, and this principle of uneven assessment, is found in all systems of taxation. While then, in pioneering communities and considering the attitude of the exploiter, a higher assessment for timberlands would appear justified than for farm properties, yet even here some just and fair principle should be applied in the assessment, and a check to arbitrariness supplied.

That forest properties are mostly unfairly taxed admits hardly of doubt, especially when it is considered that such properties do not receive the protection or other considerations they are entitled to from the municipalities which collect the tax. Not only does there seem to be no uniform principle behind the assessor's method, but the ability of the assessor to make a true and reasonable valuation is often doubtful, and his assessment is more or less a guess, a "hit or miss", but mostly a "miss".

There are only three equitable methods of assessing land property; namely, by the actual or estimated sale value as it stands with improvements, which supposedly represents its income producing value; by the actual or estimated average income or

profit or revenue which it produces; by the possible or eventual income or profit or revenue it might produce—its productive power, its rent value; or else, a tax system in which any two or all three methods are employed, supplementary to each other, might be devised.

In the case of the rent value assessment it is not the actual yield, but the yield capacity that is assessed, no matter whether the owner lets the land lie barren or uses it not in a manner most suitable to its capacity, and leaving out of consideration whether the land bears forest or is improperly stocked. What it could under reasonable management produce by its annual growth or increment, can be established for a forest acre as well as for a farm acre.

In the case of the income tax the actual net income is assessed, but in forest properties it may also be conceived to consist in the money value of the annual wood increment on the actual stock, no matter whether this is harvested annually or intermittently, or not at all, for if not utilized it becomes capital, reinvested income, invested in woodgrowth; and if it is thrifty growing timber it increases the rent producing capacity of the property by the increased wood value which comes with increased size.

Logically, the assessment based on actual income would appear the most reasonable, for eventually all taxes must be paid out of income. The practical objections are that it is difficult to ascertain actual income, and that properties allowed to lie idle would escape taxation to the detriment of the community; hence, a mixed system is more likely to produce satisfactory results.

It is, of course, irrevelant in principle whether the tax is assessed directly on income, actual or potential, or on its capitalized value, although in practical operation one or the other method may appear preferable. In the end expediency will vary the application of the method under different conditions.

Thus in the old settled countries with fully established permanent communities and practically unchangeable conditions the rent value method may be practicable, while it would be pre-

posterous to apply it to the unsettled conditions of communities in the pioneering stage.

With regard to forest properties it has been urged that the timber is really a crop and not a part of real estate, hence, should not be taxed any more that the farmers' crop. But those advocating this theory overlook that the crop idea involves the idea of human effort, and that in most cases in this country the grown timber is an asset secured without such effort.

Only when an effort has been put forward to make the soil produce can we speak of a crop. Here again the attitude of the owner and the condition of the forest is of moment in characterizing the stand either as accumulated capital to be taxed, or as growing crop to merely serve in determining the capital value of the soil, which is then the taxable property.

At any rate, it would appear reasonable to distinguish in the assessment between the soil value and the stumpage value, the former to be based on the productive capacity of the soil either for farm use or for forest use, and the tax on stumpage to be based on market values, and, of course, to cease when the timber is removed. In this connection it should not be overlooked that if stump lands are to be assessed on their farm value, that the cost of preparing them for farm use is properly deducted from the final farm value.

When you come to analyze the assessor's procedure, you will probably find that unconsciously, or half consciously, he makes such subdivision in his mind, although the assessment is stated in a lump, and the methods of arriving at the valuation are only crude guesses.

One of the latest contibutors to the discussion of equitable timberland taxation, having first raised the crop idea, somewhat inconsistently contends that "land should not be taxed at all, but the timber after it is cut into logs. This would relieve the necessity for cutting half-grown trees, allowing them to grow to maturity first." He then raises the very practical point that "a crop of logs is a definite value, obtainable from scale bills, while the value of wild land is something on which no two timberland explorers ever agree."

It has been pointed out again and again that timberlands afford no income until the timber is cut, and since taxes are, or ought

to be, paid out of income, the tax should be levied when the timber is cut, assessing the actual cut at its fair stumpage value. The principle would appear just, but the practical objection to this method is that administrations have annual needs for funds, and cannot be dependent on the whim of owners as to when and how much they propose to cut, and hence an annual tax must be levied. The method of assessment must therefore be modified to meet this necessity, which is, perhaps, also best done by a separation of land tax and stumpage tax.

This is the principle on which German forests are taxed, and it may be of interest to briefly recite the latest development in forest taxation in that country, although the methods may not be applied directly under our conditions.

In that country forestry practices, *i. e.* management for continuity being general and to a large extent enforced, all forest properties are treated in the tax scheme from that point of view. While there are variations in the method of assessment in the different States they all are, in the last analysis, based on the productive power of the soil and the tax is assessed usually both against the income and the capital invested in the business.

When a sustained yield management exists, *i. e.* one which yields an anual cut, the capital represented in the growing stock or timber is considered taxable as well as the income, while in intermittent management, instead of the growing stock, the soil rent value, *i. e.* the soil considered on the basis of its productive capacity, is the taxable property.

In Wurttemberg a revision of the tax law was effected in 1905, following closely the Prussian precedent. Both state and county taxes are assessed against forest property. For state purposes the taxable income is the actual sale results, cash or credit, of the regular cut, principal and intermediary harvest. The domestic consumption of the owner at local average prices is considered income as well. Extraordinary cuts are taxed if they are made to secure cash or to change the use of the area, as for farm purposes; but, if occasioned by natural disaster, like windfall, insect pests, snow breakage, etc., the results are not considered taxable income, for this enforced cut is considered a misfortune, a loss against the owners' interests, because it disturbs his regular management.

As expenses are charged not only all the usual expenditures

incurred in the management, but the cost of new plantations also, and bad debts of former years if they had been figured as incomes, but costs occasioned by extraordinary cuts, including those of reforestation, do not figure any more than the incomes from such untimely utilization.

Besides this income tax the hitherto customary realty or soil tax is continued at a reduced rate. This is based not on the income, but on the possible net yield—the *possibilité* of the French—and this yield capacity is determined once for all by experts, after classification of the land according to quality. This assessment of the so-called "tax capital," which does not consider individual conditions or special methods of management, is supposed to hold good for a long period, and is changed only when changes in use and in property conditions arise.

For municipal taxation this tax capital forms the basis, the annual county or town expenditure, as far as not otherwise satisfied, being apportioned among the owners. The rate on the tax capital varies from year to year, and in 1906 was 20 mills—the same as on real estate in Toronto. The rate on incomes is determined every two years. The law, however, states a normal rate on a sliding scale, which varies between 2 and 5 marks, according to size of income.

It is evident that we have not yet reached such stable conditions in the lake states to permit the application of this method, but it is, at least, suggestive. It may be of interest to add that the forest soil in Prussia is assessed in the tax lists upon the basis of a net yield varying from 18 cents to $1.25, averaging about 50 cents, while farm soils are taxed on a basis of a net yield of 81 cents to $3.96, or, $1.82 on the average.

I may not, without exhausting my time, analyze in detail the conditions of the other classes of woodland, stumplands, good and bad, from the standpoint of the tax assessor, except to point out that the attitude of both owner and assessor are naturally changed when the timber is cut, and hence entirely different principles and practical considerations enter. But still, expediency, *i. e.*, justice to the commonwealth or to the communal interests as a whole in the broadest sense, rather than theoretical personal justice, will probably dictate the procedure, and the attitude of the owner

towards his cut-over lands will, and ought to, influence the assessment.

At this point my second main question comes in: how far may the taxing power be utilized to favor the introduction of forestry methods in the treatment of woodlands, *i. e.,* to induce owners of timberlands to make them permanent revenue producers? This, no doubt, is the question which interests this convention even more than the first, namely, that of just taxation.

The principles which would justify the consideration of such woodland properties dedicated to forest purposes as special objects for tax release or exemption have been rehearsed again and again and are familiar. It is claimed, with more or less good reason, that forest growth is a condition beneficial to the community at large, through its influence on climate and water flow. I call your attention to the fact that these influences are not under all conditions evident or proven, and that the location of the forest areas has much to do with the value of their protective function. That is to say, not all forest growth has protective value.

Another argument is, that the long time involved in producing forest crops, the risks involved in this kind of crop and various other characteristics of the business of forest cropping are discouraging elements to private enterprise, and hence, taking also into consideration the general need and the general benefit which come to the community at large, this business is considered as needing the encouragement of an infant industry by reduction or exemption from tax.

I have, myself, again and again, attempted to show that forestry is a business *sui generis,* that owing to the long time element mainly, it is exceptional, and may, therefore, justify exceptional treatment even by the tax gatherer. But, admitting all the arguments in favor of the principle of partial or entire tax release as a theoretical proposition, two practical questions must not be lost sight of, namely, first, the difficulty of devising and administering an adequate tax release law, and the still more important question: Is there any reason for expecting that the benefit of the tax release will offset the objectionable features of the forestry business from the point of view of private enterprise.

There have been and there are, as you know, statutes in various

states designed to encourage forestry by tax release, tax exemption and bounties. If you will investigate the results of the earlier attempts at such encouragement, you will find that they are practically *nil.* And if you will scrutinize even the newer legislation you will find that it is mostly not only crude, impracticable to administer and from the forester's point of view inadequate, but they usually limit the area which is to enjoy the release to small wood lots, as if a larger area devoted to timber growth would not be a benefit to the community. They limit the kind of trees to be considered eligible for tax release specifically, instead of in general terms. They prescribe lowest limits of the number of trees which would never produce satisfactory results. They limit the length of time for which the release is given, without adequete reasons.

While I would not deny the possibility of framing adequate legislation and its practical administration in states where competent forest commissions are in charge, I wish to raise doubts as to whether this encouragement can reasonably be expected to do much good, except perhaps in the case of the small farmer's wood lot. When it comes to raising a nation's and even a state's log supply—the much more important problem—the matter is very different.

Even with the small wood lot plantation the benefit of tax release compared with the necessary expenditure on one hand and compared with the financial result of the venture on the other hand, can hardly be adequate. At best the tax release would average barely more than 10 cents per acre, which at 5 per cent. would at the end of 30 years have accumulated to $7.90. But to plant the acre and keep it in condition the expenditures would certainly not have been less than $10 in the first place, and at the end of the period would have accumulated to $50. That is to say, you invite the owner to invest six times the amount of the release to secure its benefits, if this were the amount and time for the tax release. On the other hand, if a log proposition of white pine were involved, I have no doubt that with the increase in timber values in 60 years *the original investment* of $15.00 would prove a 12 per cent. investment, and more likely 20 per cent. would be realized. How does such encouragement compare with that of the tax release?

But, on the other hand, will even the promising returns from a forest growing venture induce private enterprise to engage in this business, the profits of which are so long in coming, the risks of which are not only great, but the future of which is clouded somewhat in uncertainty?

If I were for a moment to abandon the position of the charging judge and express an opinion, I would declare that forestry is the business of the state, or the community, if for no other reasons than because of the long time element involved; that only large capital and large continuous corporations can really afford to go into this long-winded business, and that to such the small tax releases cannot possibly act as an inducement.

The sooner, therefore, the stumplands either by abandonment for tax or otherwise fall into the hands of the state or corporation, and the sooner these realize that the future of timber supplies and favorable monetary returns are their concern, the simpler will become the tax question.

There is one other form of taxation which has sometimes been believed to have a bearing on forestry practices, namely, a customs tariff. I remember a committee of lumbermen waiting on me at Washington to ask me to assist their tariff agitation by an argument which should show that a tariff of $2 per 1,000 feet would promote forestry. I promised to do so, if they in turn could vouch that at least one-half of this tax on the public would find its way from their pockets into the woods for improved practice. Needless to say, that the argument was not called for. Where, as in Germany, a well established forestry system needs protection against the imports from exploiting countries, the argument might appear reasonable, but as a matter of fact, even there the tariff duty was counterbalanced by a reduction in freight rates of the exploiting countries, and has not had the desired effect. Theoretically, an import duty on lumber should make timber lands so valuable as to induce the conservative use of them, practically such a result has not been experienced, the present dollar being a greater attraction than the possible future two.

Conditions in Ontario.

I may be expected to add a few words as regards conditions in Ontario, my newly chosen field of activity. As is well known,

the bulk of forest properties, some 90,000 square miles, is owned by the crown, or virtually by the province, and hence pays no taxes. The so-called "ground rent" which is paid by the lumbermen, holding timber limits from the crown, in addition to the stumpage dues and the bonus, can hardly be classed as a tax; it is rather a payment per unit area irrelative of values for the privilege of continuing to hold on to the limits. It can be readily demonstrated that the present method of selling timber limits, while, for the moment financially successful, is really destructive, and inimical to forestry practice. But this is a subject which does not belong here.

Regarding the taxation of privately owned lands, and timber lands especially, the same or even a greater lack of equitable and uniform methods of assessment than in the states exists throughout Canada. Since only towns and municipalities raise direct taxes and no uniform law of taxation exists, each assessor is a law to himself, and an all pervading principle of assessment is not discoverable. On the whole the burden has not been great, and hence clamor for tax reform has not been heard. Lately, however, some municipalities had undertaken to levy excessive taxes on crown timber limits, and this provoked appeal to the courts, which naturally declared the limits exempt.

Ontario, in its 222,000 square miles of country, equal in size to the States of Michigan, Wisconsin and Minnesota, exhibits such a great diversity of cultural and populational conditions, that necessarily from region to region at least different points of view and different methods of assessment must continue to prevail for a long time to come. The southwestern portion, the rich agricultural section, bordering on the lakes, where the bulk of the 2,500,000 people live, is almost destitute of timber, and even farmers' wood lots are scarce. The northeastern part is largely covered with cut-over timber limits and stump limits, and since the agricultural soils are rather scanty, this will be eventually the great forest region. It is from this region that I cited the case of a timber land owner who is satisfied with tax conditions. Conditions of transportation rather more than taxation are the prominent considerations. North of Lakes Huron and Superior the districts of Rainy River, Thunder Bay, Algoma and Nipissing, a

territory of some 90,000 square miles is, still almost entirely in the woods, to a large extent of inferior character, and mostly still government land where the tax gatherer has not yet found entrance. In the agricultural regions the government of the province has very properly, for the last two years, begun to encourage forest planting on waste lands by furnishing cheap plant material and advice. Whether the municipalities will release these plantations remains to be seen.

There is on the statutes an act, passed in 1906, providing for the exemption of woodland from taxation, one acre in ten, and not more than twenty-five, with the usual limitation of numbers of trees ridiculously low, and limitation of species. The application of this law is optional with the council of the township, and so far does not seem to have found acceptance anywhere. On the whole, as far as I have been able to ascertain the tax question in Ontario is not a burning one, like such others as fire protection, export tariffs, settlers' restrictions and reform in timber limit sales.

In conclusion, while I may have left the impression that not much hope is to be placed on the use of the tax power for advancing forestry practices, I am convinced that the discussion of the subject of taxation must be of considerable educational value, and that the effort to devise an equitable and uniform tax assessment, wherever such uniformity is practicable, is to be encouraged.

B. E. Fernow.

LUMBERING IN THE PHILIPPINE ISLANDS.

Although the future prosperity of the Philippine Islands depends mainly on their agricultural development, yet it is generally recognized that the proper exploitation of the extensive Philippine forests will add exceedingly to the future prosperity and also aid greatly in agricultural development of the country.

More than one half of the land area of 120,000 square miles in the Islands is forested, that is, covered with a tree growth. Of the 60,000 square miles of forest, 40,000 square miles are in the more thinly settled islands of Mindoro, Samar, Palawan and Mindanao, or about eighty per cent. of their total area. This leaves 20,000 square miles of forest in Luzon and the other well settled islands, or about 30 per cent. of their total area.

It must be admitted however, that large parts of this timbered area cannot be considered commercial forest by lumbermen. Scattered stands of small unmerchantable trees and inaccessible mountain forests cover considerable areas. Estimating conservatively there are 25,000 square miles or 16,000,000 acres of timber per acre on this area is a conservative estimate, giving a scale. An average yield of 2,500 board feet of merchantable timber per acre on this area is a conservative estimate giving a total supply of forty billion board feet. The total annual cut in the Islands is now about forty million feet or only one-tenth of one per cent. of the probable supply. This cut is an insignificant item of the annual growth in these forests. The forests under conservative treatment should furnish an annual supply of at least 400,000,000 feet without seriously affecting the timber supply of the future.

The timbers of the Islands include a great variety, ranging from the Benguet Pine and Calantas, or soft tropical cedar, to the extremely heavy and hard Dungon and Mancono. In general, Philippine woods are hard and heavy yet there are not lacking abundant supplies of light and strong construction timbers which can well be substituted for the White Pine, Oregon Pine and

California Redwood, which are imported. Lauan is a fairly soft, strong wood and can well take the place of White Pine and California Redwood. Apitong, harder, heavier and stronger than Lauan, is equal or superior to Oregon Pine and Longleaf Pine, for general construction. Lauan and Apitong and the other species of the same family, Dipterocarpaceae, are not only the most abundant timbers occurring in the archipelago, but they are very large trees. Timbers up to ninety feet in length can be secured from them. They are also excellent finishing woods, equal to most American woods used for interior finish.

The following comparative figures of weight and strength are taken from Bulletin No. 4, Bureau of Forestry, "Mechanical Tests, Properties and Uses of Thirty Four Philippine Woods."

		Compression along the grain.		Cross-bending.			
Name.	Locality.	Average per cent. moisture.	Average stress at rupture (pounds per square inch).	Average per cent. moisture.	Average modulus of rupture (pounds per square inch).	Average modulus of elasticity (1,000 pounds per square inch).	Average specific gravity of dry wood.
Lauan,	Phil. Is.	12.4	6,180	10.4	9,760	1,653	.446
Oregon Pine,	U. S.	12.	5,700	12.	7,900	1,680	.51
California Redwood,	U. S.	13.3	5,560	12.3	9,110	1,320	.445
Apitong,	Phil. Is.	14.4	7,250	14.	11,620	2,144	.645
Longleaf,	U. S.	15.	6,900	15.	10,900	1,890	.61
Guijo,	Phil. Is.	14.6	7,940	13.7	15,150	2,158	.708
White Oak,	U. S.	12.	8,500	12.	13,100	2,090	.80
Pignut Hickory,	U. S.	12.	10,900	12.	18,700	2,730	.78
Dungon,	Phil. Is.	10.7	9,420	11.6	17,110	2,209	.857
Yacal,	Phil. Is.	13.4	9,220	15.6	15,690	2,583	.843
Molave,	Phil. Is.	12.7	8,330	10.4	8,580	1,614	.785

Some of the finest cabinet woods in the world are found in the Philippines. Ebony, Acle, Narra, Camagon and Tindalo give the greatest choice in beautiful color and grain. These and others would make superior substitutes for the American cabinet woods

which are so rapidly disappearing. For Cherry and Mahogany, Narra, Tanguile, Balacbacan, Calantas and Lumbayao, though differing somewhat in grain and hardness, can be used; for Black Walnut, Acle and Banuyo can be used; and so on, every American furniture wood having numerous Philippine substitutes. Besides there are valuable woods such as Ebony, Camagon and Tindalo which have no counterparts in the United States.

The principal commercial woods are equal to our best American hardwoods and can well take their place.

At present Phillipine lumber is produced almost exclusively for the local demands. In the fiscal year 1904-5 the Islands used about seventy-five million board feet of lumber, of which they produced about forty million feet. The remainder was imported from the Pacific coast. It seems anomalous that a country so rich in timber should not produce more than one-half of the supply necessary for its own people. The reasons are that lumbering is generally on such a small scale and with so inefficient methods, and facilities for transportation of timber among the islands at present are so poor that Oregon Pine is sold in Manila and other large cities, cheaper than most native lumber.

Conditions demand the development of a modern lumber industry and the installation of large sawmills and suitable transportation facilities so that Philippine lumber can dominate in the Philippine Islands and penetrate to foreign markets. Large operations, well capitalized and efficiently managed, are necessary if the Philippine people are to receive a proper economic benefit from the possession of their valuable forests.

The company desiring to establish a large lumbering operation in the Philippines cannot study too carefully the factors governing the lumber industry here. These factors are the character of the forests, the accessibility of the timber, transportation facilities, labor conditions, stumpage prices and market conditions.

Character of Phillipine Forests.

A lumberman demands in a commerical forest, accessibility, comparatively few species per acre, most of which are merchantable, and enough merchantable timber per acre to permit the use of modern logging methods. Large areas of Philippine

forest although containing the most valuable timber fail to answer these requirements.

In general Philippine forests are tropical rain forests, most of which in the world are found in Central and South America and in the East Indies. They are generally characterized by an exuberance of tropical growth and a bewildering variety of timber species. The greatest variety of forests is found in those regions subject to an island climate as in the Philippines. The many types of forest in the Philippines are all of economic importance.

In Benguet and neighboring provinces at an altitude of more than two thousand feet are the open pine forests. Along the coasts, especially at the mouths of the rivers, are extensive salt water or tidal swamps, known as manglares, from which come firewood, tanbark and dyebark. The low coast flat is another forest type, characterized by scattered trees of Ipil and a few other valuable species The tangled forests of the deltas and river bottoms present the greatest variety in species but are not satisfactory for extensive lumbering Finally there is the extensive hill or upland type of forest which is the most suitable for lumbering operations

The upland forests are the most extensive and are the ones in which the lumbermen will be most interested in the future. There are two general classes of upland forest, depending generally on soil conditions.

On rocky, exposed, and thin-soiled uplands the forest is thinner and is characterized by a smaller proportion of commercial species. Here Molave, Narra, Tindalo, Acle and other of the most valuable trees are found scattered through a stand composed mostly of small unmerchantable trees. The other type of upland forest is found on the better, deeper soils. Here is generally found a fairly dense stand of large trees principally members of one family, Dipterocarpaceae. The best example of this type is the forest in northern Negros where the Insular Lumber Co. is now operating. Here Balacbacan, Red Lauan, Almon, White Lauan and Apitong make up a stand of 32,000 feet B. M. of merchantable timber per acre. This type of forest naturally answers best the requirements of modern logging and upon it will largely depend the development of an extensive lum-

ber industry. Both classes of hill forests are found throughout the Islands. Good examples of the former are the tracts of the Philippine Lumber and Development Co. in Camarines; the Tayabas Sawmill and Lumber Co. in Tayabas; the coast forest of southern Negros. Examples of the latter are, besides the forests of northern Negros, those of the mountains of the Bataan peninsula and east of the head of the Cagayan River in Cagayan and Isabela Provinces.

The Bureau of Forestry is gradually locating and roughly mapping the best commercial forests of all these types. The information thus collected is available to all interested parties.

Accessibility of Commercial Forests and Transportation.

The commercial forests are found either along the coast where the timber can be skidded directly to the beach and loaded in suitable harbors, along navigable and floatable rivers, where it is skidded directly to the rivers and floated or rafted down them, or at some distance inland, so far from deep water that short railroads are advisable or necessary. As long as timber remains close to the beach and large rivers, logging is easy and cheap; requiring but little capital. In such forests there are a large number of small operators, cutting insignificant quantities of timber. But these forests are being fast destroyed by the farmer. Lumbering, in the future, will be in the extensive forests some distance from the coast where carabao will not serve for hauling and logging railroads are indicated.

The difficulties and expense in transporting lumber to the markets are great. A lumberman who does not own his own boats is handicapped. Few of the interisland steamers are adapted for carrying lumber and freight rates are high and sometimes prohibitive. From the island of Palawan to Manila, a distance of about three hundred miles, the freight rate for logs is about $30 gold per 1,000 feet, B. M. Such rates are manifestly absurd. From Manila to New York, thousands of miles, the rate is only $15 gold per 1,000 feet, B. M. Only the good prices in Manila make it possible to ship native lumber under such conditions.

A company operating on a large scale should own its own

means of transportation from the woods to the market. The Insular Lumber Co., who are operating more extensively than any other lumbermen in the Islands, have a fleet of steamers and barges to transport the sawn lumber to the markets of Cebu, Iloilo and Manila. Freight from their mill in the island of Negros to Manila costs them less than $5 per 1,000 feet, B. M.

It is reasonable to expect that lumber can be shipped between most points in the islands at a cost not exceeding this figure.

Labor Conditions.

The oft repeated saying that Filipino labor is inefficient does not apply in the lumber industry. Dollar for dollar of outlay much better results will be secured, both in the woods and in the sawmill, from Filipino labor than from American labor. The Filipino has a natural aptitude for running machines and is easily taught. Given a good American foreman it is surprising how well a Filipino crew can handle a sawmill. They work for small wages—$.25 and $.75 (gold) per day—and, given fair treatment, make fairly steady and permanent workmen.

In the thinly settled forest regions it is necessary to import labor from the more thickly settled districts. Yet there are tracts of commercial forests so located that there is an abundant and good supply of labor available in the regions themselves. The Insular Lumber Company is located in the sugar growing district of Negros where labor is abundant and cheap. It has found no difficulty in securing a force of several hundred men most of whom it pays $.25 per day. The laborers are satisfied and work well.

A lumberman will not find the labor problem a difficult one. He will find that he has escaped many of the vexatious labor difficulties of the United States to meet comparatively few in the Philippine Islands. Patience and fairness in treating the Filipinos will secure most excellent results.

Stumpage Prices.

The Philippine Government sells its timber unusually cheap. The government charges range from $.25 to $1.25 gold per cubic meter, or approximately $1.00 to $5.00 per 1,000 board feet.

$1.00 per 1,000 board feet is charged for Lauan which sells in Manila for $35 per thousand board feet. Similar grades of California Redwood for export are worth $25 to $30 in San Francisco and stumpage at present cannot be secured for less than $2 per thousand feet. The cheap Philippine stumpage is still more marked in the fine cabinet woods. For Narra and the other most valuable woods, it is but $5 gold per 1,000 board feet, less than pine stumpage in some parts of the United States.

Markets.

The lumberman, however, is not satisfied alone with a satisfactory forest, cheap labor and stumpage and good transportation, but probably wants to know first what the market is for Philippine timber.

Approximately 80,000,000 feet B. M. of lumber is used each year in the Philippines; of this more than thirty-five million feet is imported, being mostly Oregon Pine and California Redwood. The imported timber is being driven out of the Islands' markets by the cheaper and more abundant kinds of native timbers. About 5,000,000 board feet has recently been added to the consumption of native timber by the decision to use native lumber almost exclusively in construction for the U. S. Army in the Philippines. China and Australia used of American pine during the past year 85,000,000 and 63,000,000 board feet respectively, a large part of which demand can be furnished by the Philippine Islands when their Apitong and Lauan have been introduced in those markets by large lumber companies properly equipped and capitalized.

	Per 1,000 feet B. M.		
Lauan,	$ 35 00	to $	45 00
Apitong,	42 50	"	50 00
Guijo,	49 00	"	70 00
Molave,	107 50	"	150 00
Yacal,	80 00	"	100 00
Red Narra,	125 00	"	150 00
Tanguile,	47 50	"	60 00
Ipil,	90 00	"	112 00
Oregon Pine,	37 50		
California Redwood,	47 50		

It is evident from these prices that a lumber company, properly equipped and managed and operating on a suitable timber tract, should be able to deliver many kinds of native lumber in Manila at a cost about one-half of these prices. Cheap labor and low stumpage offset the increased expense of machinery and management in the Philippines. Experience has shown that Lauan can be logged to a sawmill for less than $5 gold per 1,000 board feet, sawn for $3 and delivered in Manila for a total cost of about $15.00.

There should always be an opportunity for small operators in supplying the local provincial demands but the growth of a lumber industry worthy of the Islands will depend on the investment of considerable capital. Lumbermen should be prepared to handle the lumber in all stages from the forest to the market. In this way they can compete successfully, not only in the Philippine, but also in Chinese, Australian and even American markets.

The following distances to markets show the advantageous position of the Philippine Islands in competition with the Pacific Coast:

Distance from	Manila, P. I.	Cebu, P. I.	Iloilo, P. I.	Hongkong, China.	Shanghai, China.	Sydney, Australia.
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
Seattle, U. S. A., ...	6,400	.....	.....	6,300	6,200	6,800
Cadiz, Negros Occ.	400	140	70	800	1,300	3,370
Bongabon, Mindoro, ...	200	.....	.....	700	1,200	3,570

A market for Philippine lumber should also be secured in the United States. Most Philippine timbers are unexcelled for cabinet work, interior finishing, etc., where beautiful hard woods capable of high polish are required. Such woods are rapidly disappearing in the United States. The difficulty has been that there were no lumbermen in a position to supply a strong demand. Consequently the fine Philippine woods are still unknown in the United States. The Insular Lumber Company has taken an important step in developing an American market by shipping to the United States sample lots of its Balacbacan, a beautiful red wood, which is very abundant in Negros.

The lumbermen, however, who now contemplate lumbering in the Philippine Islands can not figure entirely on what the market may be but must depend mostly on what it is now. He must feel that he can secure his share of the local trade. The following were the prevailing prices in Manila, August 1, 1907, for some of the principal native woods, Oregon Pine and California Redwood.

Present Lumbering Operations.

Lumbering at present is mostly carried on in a crude, inefficient way by numerous small butters, few of whom cut a significant amount. There is also a great waste in logging. Skidding and hauling are done with carabao, which are poor draught animals for this purpose. Several carabao are needed to move an ordinary log and much of the timber is too large to be hauled by them. In this kind of logging the requirements for cheap logging are lacking, and the output is necessarily small.
Islands.

The following is a list of sawmills now operating with their location and output:

List of Sawmills.

Location.	Maximum daily output (board feet).	Principal Markets.
Manila, P. I., ...	30,000	Manila.
" "	20,000	"
" "	20,000	"
" "	10,000	"
" "	10,000	"
Cadiz and Sagay, Negros Occidental.	15,000	Manila, Cebu, Iloilo and New York.
Cadiz and Sagay, Negros Occidental.	60,000	Manila, Cebu, Iloilo and New York.
Gattaran, Cagayan, ...	(a)	Local.
Fiuelisen, Lepanto-Bontoc, ...	1,500	"
Baguio, Benguet, ...	2,500	"
" "	3,500	"
" "	4,000	"
Bayombong, Nueva Viscaya, ...	(a)	"
San Antonia, Tarlac, ...	2,500	Manila.
Murcia, Tarlac, ...	(a)	Local.
Bolinao, Pangasinan, ...	(a)	"
Pinamalayan, Mindoro, ...	5,000	Manila.
Mamburao, Mindoro, ...	5,000	Local.
Mangarin, Mindoro, ...	10,000	Manila.
Guinayangan, Tayabas, ...	15,000	"
Ragay Gulf, Ambos Camarines, ..	(a)	"

Location.	Maximum daily output (board feet).	Principal Markets.
Tacloban, Leyte, ...	3,000	Local.
Palompan, Leyte, ...	4,000	Cebu and local.
Dumaguete, Negros Oriental, ...	3,500	Local.
Iloilo, Iloilo, ...	4,000	Iloilo.
Isabela, Basilan Island, ...	6,000	Zamboanga.
Zamboanga, Moro, ...	(a)	Local.
Cotabato, Moro, ...	(a)	United States Army.
Parang, Moro, ...	6,000	" " "
Marahui, Moro, ...	(a)	" " "
Sibuguey Bay, Moro, ...	(a)	Local and Philippine Ry.

(a) Small mill.

Since the American occupation, the number of small sawmills has greatly increased yet a large part of the native timber used in the Islands is whip sawed. The last two years have seen the greatest increase in the number of sawmills operated.

These mills are well distributed through the Islands, most of them supplying purely local demands, such as those in Benguet manufacturing Benguet Pine. Some have been installed to cut timber for the construction of the new railroads. The mills in Manila and the larger ones outside saw almost exclusively for the Manila market.

These thirty-one sawmills cannot manufacture more than 250,000 board feet of lumber per day. Of this 90,000 feet can be cut by the five Manila mills. One sawmill in Negros has a nominal capacity of 100,000 feet B. M. and should cut at least 60,000 feet per day. This indicates well the condition of the lumber industry at present. Extensive lumbering is only beginning in the Philippine Islands. Yet, there are a few operations now being successfully carried on which indicate to lumbermen the possibilities in the Philippine forests.

The operatons of the Insular Lumber Company in Negros Occidental are more extensive than those of any other company in the Islands. It is operating two sawmills on a tract of sixty-nine square miles, sixty square miles of which are covered with an unusually heavy stand of timber, averaging about 32,000 board feet of merchantable lumber per acre. The smaller mill which has been in operation since 1902 has a capacity of 20,000 board feet per day but the daily output is about 12,000 feet. The other mill which has recently been completed is a modern band mill of

the best type with a capacity of 100,000 board feet and should manufacture at least 60,000 board feet per day when a mill crew has been trained. This company is able to sell Lauan and Apitong cheaper than other lumbermen and can sell it in Manila at a much lower price than that prevailing for Oregon Pine or California Redwood. Their operation is an example of what can be done in the Philippines by a well equipped company operating with modern methods. Donkey engines are employed to skid the timber to a logging railroad on which the logs are hauled to the mills. The company's steamers and barges carry the lumber to Manila, Iloilo and Cebu.

Another operation worthy of mention is that of Mr. John Gibson in Mindoro. He is operating over a large tract in which Narra, often called the Philippine Mahogany, is fairly abundant. His mill is located in Manila, to which he transports the logs in his own steamers.

Other companies operating on large tracts are the Philippine Lumber and Development Company in Camarines, the Tayabas Sawmill and Lumber Company in Tayabas, and Williamson and Redding near Zamboanga. Considerable interest is being shown by capitalists in Philippine lumbering. The Bureau of Forestry has recently received a number of applications for exclusive licenses for large timber tracts.

Suitable Timber Tracts Available.

In pursuance of its policy to do everything possible to stimulate the forest industries of the Philippine Islands, the Bureau of Forestry, during the past two years has located and roughly mapped timber tracts suitable for large operations. It is now in a position to give definite information regarding some such tracts to prospective lumbermen.

In northern Negros are sixty square miles of dense virgin forest, similar in species and equal in yield to the forest of the Insular Lumber Company which adjoins it. This forest covers the slopes of Mount Silay, ranging in elevation from two hundred to four thousand feet above the level of the sea. About forty square miles lie below one thousand feet and are an ex-

cellent lumbering proposition for a company with a large capital. The new railroad in Negros is planned to pass within three miles of the edge of the forest. A company could build its sawmill on this railroad, run its own logging railroad into the forest and ship its lumber to a port on the coast to be loaded for Cebu, Iloilo, Manila or Hongkong, and New York. On the forty square miles most accessible is a total stand of about 800 million board feet of merchantable lumber, enough to supply a mill cutting 50,000 feet per day more than fifty years. It is a Dipterocarp forest, that is, composed mostly of Lauan, Apitong and Tanguile.

In the well forested region of northwestern Mindoro is another suitable tract of forty square miles. It is located southwest of lake Naujan and about thirteen miles from Calapan, the provincial capital. This also is a Dipterocarp forest composed mainly of Almon, Lauan, Tanguile and Apitong. A rough survey showed an average stand of about 20,000 board feet per acre or a total of 512,000,000 board feet standing on the forty square miles. The topography is suitable for lumbering, characterized by clay hills running up to eight hundred feet above sea level. The slopes are gradual, making logging easy. Logs may be rafted across the LLake and down the river to the coast, or a tramway built direct to Calapan which is about twelve hours by steamer from Manila. In addition to this tract there are others somewhat smaller in the same region which deserve attention.

On the peninsula of Bataan across the Bay from Manila, covering the slopes of Mariveles mountain is another forest tract suitable for a large lumbering operation. Although logging is much more difficult here than on the other tracts mentioned, the proximity to Manila makes it a good proposition. Extensive lumbering will soon begin on this tract.

Other important forests which will soon be explored and studied by the Bureau of Forestry are found east of the Cagayan River in the Province of Isabela and Cagayan, in the undeveloped southern portion of the island of Negros, on the Agusan River in Surigao, Mindanao, and on the Sibuguey Bay, Moro, Mindanao. These forests are said to be accessible and suitable for exploitation on a large scale. Many other good commercial forests will be investigated as soon as possible.

Obtaining a Tract of Timber.

The public forests of the Philippine Islands are not sold, but are exploited under a license system. Small cutters generally operate under ordinary yearly licenses for definite small areas.

In the case of large operations involving the investment of considerable capital in permanent enterprises, exclusive licenses are granted for periods up to twenty years for definite large tracts of timber, which licenses are practically equivalent to consessions.

Application for tracts not exceeding 2,500 acres in area are forwarded by the Director of Forestry, after due investigation, to the Secretary of the Interior with recommendations. The Secretary may then grant an exclusive license if he decides that it is to the public interest.

For an area of more than 2,500 acres, when the Secretary of the Interior is convinced that the granting of an exclusive license is to the public interest, proposals for bids to secure the said privilege are published in the Official Gazette and other newspapers. The license will then be granted to the highest and best bidder who offers to install the most complete and efficient plant most promptly and to do the greatest amount of annual development work and who furnishes the best bond as a guarantee of performance.

The right to reject any and all bids is expressly reserved and in general it may be stated that no exclusive license will be approved except upon a reasonable showing that the licensee will be able within the period fixed in his license actually to exploit the resources of the forest tract covered by it. The man who means business must show the government that he really intends to develop the tract he secures an exclusive license for and will protect the interests of the public in the concession.

The exclusive license agreements are contracts between the Government and the lumbermen. The latter can feel assured that if they comply with the forest laws and regulations and show good faith that they will be entirely safe in making large invesments and installing permanent modern plants.

The Bureau of Foresry is now in a position to assist lumbermen desiring to locate here. Some have recently made applications for exclusive licenses for large tracts and have found the

maps and information furnished them by the Bureau, of great value. Trained foresters with two or more years of experience in the Philippine forests will be placed at the service of lumbermen to assist them in finding suitable forest tracts. The available publications of the Bureau will be sent on application to interested parties.

Lumber is bound to become one of the greatest sources of wealth in the Philippine Islands. The growth of the industry may be slow but present indications point to a bright future for Philippine lumber.

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THE TREATMENT OF FENCE POSTS TO INCREASE DURABILITY.

The past two decades have witnessed a wonderful development of the agricultural resources of our middle West. We no longer find open stretches of prairie of great extent, but fields and pastures and wood-lots divided by fences of various kinds, which call for a large number of fence posts. The census of 1900 reports the annual production of fence posts in the regular logging camps of the country as 8,715,661, while no figures exist to show how many times greater than this is the annual cut from the home wood-lot.

By taking the total number of farms and their acreage and making a conservative allowance for posts in fences enclosing these farms, it has been estimated that upwards of 1,000,000,000 posts are set each year. This figure can hardly be realized because of its immensity, but we may approach realization when we know that the above number stated as required each year would make a fence, with posts a rod apart, 121 times as long as the greatest circumference of the earth. This enormous annual consumption of posts on our farms, to say nothing of posts used by railroads and in our villages and cities, is causing an increasing scarcity of post timber, until one must pay now from 15 to 30 cents for only fair grades of hard wood and cedar posts.

To simplify the fence post problem on our farms and to decrease the large expense of fencing, many are now turning to the use of various preservatives which at a small cost will increase the life of the post two or three times. It is true that many are tempted to use substitutes of various kinds, such as cement and iron posts. It is believed that a thorough trial or these substitutes will turn the farmer back to the use of a wooden post thoroughly treated with creasote or some similar antiseptic.

Four things are necessary for the decay of timber, namely, air, warmth, water and some fungous growth. If we can eliminate any one of these factors of decay, we can preserve wood almost indefinitely. All processes of timber treatment are based upon

this fact and treatment is given simply to prevent the entrance of a fungus. The value of any method of treatment lies then in the value of the preservatives used as an antiseptic, in its power to hold itself in the wood, and in its cheapness and ease of application.

Too often lack of time causes the farmer or stockman to go to his wood-lot and cut the posts when they are needed, which may be at any season of the year. The posts are then set without peeling or seasoning of any kind. What is the usual result? The posts, because of the presence of bark and because green will go out in from 3 to 5 years when if cut at the right season of the year, peeled and thoroughly seasoned they would last from two to three times as long.

The best time to cut hard wood posts is in late summer or early autumn when the "sap is up," or during the time which the lumberman calls "the second running of the sap." If the posts are peeled immediately and ricked up so as to allow free circulation of air between them, they will season rapidly and be much more durable than as if cut during the winter or early spring. Seasoning may be aided by allowing the fallen trees to lie on the ground after cutting until the leaves are thoroughly wilted. It would be practical business economy for the user of posts to keep a considerable number cut and piled so that when needed he would always have a seasoned post.

Methods of Increasing Durability.

One of the cheapest and a very effective method of increasing durability is thorough seasoning. With fence posts this may be accomplished as described above in from 8 to 16 months, depending upon the species, size and whether properly peeled and piled. Under no circumstances should posts be stood on the end during seasoning, as when so piled the post absorbs water and a condition which invites the entrance of fungi is brought about.

Since 30 to 60 per cent. of the weight of green timber is due to the sap present in the wood, it will be seen readily that seasoning is also an important factor in case of handling and cost of transportation.

A method formerly much used and of considerable value is that of thoroughly charring over a slow fire the portion of the post which is placed in the ground, breaking as little as possible of the charcoal from the post during setting.

Water and smoke seasoning are methods sometimes used when unusually thorough seasoning is required. There is no doubt but what immersion in water dissolves such soluble substances in the wood as starch, sugar and tannin. The leaching out of these materials takes away the substances which often invite the entrance of insects and fungi. The U. S. Forest Service has been carrying on a series of experiments in Michigan and Wisconsin in which Cedar and Tamarack telephone and telegraph poles are being submerged in water for varying lengths of time. The time required for seasoning by these methods is the chief drawback.

We often see a combination of linseed oil and charcoal dust advised for increasing life of timber. Linseed oil is good but not nearly so effective as creosote, and a mixture of linseed oil and charcoal dust is more disagreeable to handle, more expensive, and less effective in increasing durability than creosote.

Numerous salts, such as those of zinc, copper, iron and magnesium are often used and they have a high antiseptic value, but as they are easily leached out of the wood and not as easily applied as creosote they are undesirable for use in preserving fence posts. Some of our railroads are using chloride of zinc very extensively in the treatment of ties, but the ties are only used in the dry climate of our southwest where there is comparatively little danger of the leaching out of the salt.

Antiseptic salts and oils are applied to timber to increase durability. First by pressure in cylinders, second by natural pressure, third boiling in liquids, fourth in the case of oils by application with brush or merely soaking the timber in the oil. The preservative may have simply a physical effect on the wood, by encrusting the cell walls, or may have a chemical effect, by combining with the wood fibres or cell contents.

From all standpoints, the best material so far found for increasing the life of fence posts is the oil of tar or some trade compound in which the oil of tar is the active principle. Creosote is the most common form of this oil used in timber preserving plants

of the country and by farmers and stockmen in preserving fence posts.

The most usual method of applying oil to posts is by painting the lower half of a seasoned post with the hot oil. Two coats will be more effective than one, and if this process is followed, by allowing the lower end of the post to stand in the oil for several days it will be more effective. The manufacturers of trade preparations containing tar oil usually advise this method of application because it is simple and easy and by testing it has been found to be fairly effective in preventing decay.

By experiments carried on in several places in this country, it has been found that the most valuable method of treating posts with creosote or other oils is to boil the lower 36 to 40 inches of the second post in a shallow tank. By giving this treatment from four to six hours the lower one-third of the post will take up from four to eight pounds of the oil. When evenly absorbed it has been found that this amount is sufficient to increase the life of the post by three to four times. Such soft wooden fence posts as those of soft maple, boxelder, cottonwood, and willow can be treated at a cost of from 6 to 10 cents and when so treated will last as long as the best grades of white cedar. A tank which would be perfectly satisfactory for this work could be built and set in place upon any farm for from ten to fifteen dollars.

Experiments along this same line are being carried on by the United States Forest Service and splendid results are being obtained. It is impossible to estimate the importance of making it a practical thing for the many wood-lot owners of the state to utilize for posts the trees which are of little value for lumber.

HUGH P. BAKER.

"CONGRESSIONAL TOURS."

The last six months have seen a new departure in co-operative work with private owners, a change from the old method of elaborate working plans (?) or wood lot examinations which did little real good, and at best reached only a small percentage of the population. The copious distribution of literature on forestry is not enough; for in order to be of any profit to the recipient he must be already instructed in the subject, otherwise his reading will be desultory. In order to interest the farmer in forestry, it is necessary to put it up to him personally and show him clearly (1) what to do, (2) the advantage it will be to him to do so. We must not forget that the chief appeal is to a man's purse strings, when urging him to take up a new thing.

This new departure is the "Congressional Tour" as it has come to be known, or "Farmers' Institute" as the Congressmen prefer to call it. One of them aptly named it "A Tour of Material Development," and this, in truth, is what it is.

The credit of evolving this scheme belongs to Captain Hobson, of Alabama, who was the first to organize a tour. The "experts" were chosen from the Department of Agriculture—the Bureaus represented being that of Plant Industry, Soils, the Office of Roads, and the Forest Service. The Hobson tour was such a great success that other Southern Congressmen hastened to follow suit, and now there have been besides another tour in Alabama, three in Georgia, two in North Carolina, two in Tennessee, and one in Mississippi.

These tours have, in all cases, been fully advertised and the attendance, if not large, representative. The audiences varied in number between fifty and two thousand, with the average somewhere around one hundred and fifty.

The talks were plain and matter of fact. The "experts" contented themselves with "'splanifyin'" and "argifyin'" and left it for the Congressman to put in "de rousements" if he saw fit. Politics were not mentioned and many of the audiences were, I believe, secretly disappointed because of the lack of invective and personal recrimination which characterize the political speech.

Questions from the farmers were encouraged and in this way the real need of the people brought out. It was much more of a "heart to heart" talk than a set speech and consequently the cases of listeners going to sleep were very rare. Indeed the interest throughout was good and the real needs of the farmers were met as never before in the old days of bulletins and voluminous long-distance reports.

It is not a pleasant thought that in spite of all the propaganda work which has been done, the knowledge of forestry encountered was largely negative. It can only be explained by the fact that the methods employed were not conducive to overcoming the local spirit of indifference which expressed itself in "We folks don't know nothing about nothing, and we don't want anybody to tell us nothing about nothing."

No, the men on the tour found a virgin field as far as forestry is concerned, and it was necessary to start out with a brief account of what forestry means and the need for it throughout the whole country, and how that need could be best met in the immediate region. To this end I found the most effective means to be a couple of enlarged photographs showing "the right and the wrong way." One was of "skinned" land in northern Michigan, the other a cutting area on the Minnesota National Forest. These two pictures, illustrating, as they do, the difference between Improvident Exploitation and Conservative Lumbering, served to draw and hold the interest of the audience and to impress the point on them better than any verbal description.

Great interest was shown in the conservative treatment of farm timbers, especially fence posts. The simplicity of the open tank treatment and its adaptability to the "sorry" second growth trees appealed to the farmer as a good common sense proposition, and inclined him to think favorably of "the forestry business."

It was in the town of Andover, New Hampshire, that an old farmer told me that "there ain't much forestry in Andover." Wherever these tours have been held they may not result in much intensive forestry, but if the farmers will realize the value of their woods, cut conservatively and utilize completely what they do cut, a great deal of good will have been accomplished.

A. B. Recknagel.

CURRENT LITERATURE.

HENRY S. GRAVES, *in Charge.*

Plant Physiology and Ecology. By Frederic Edward Clements, Ph. D. New York: Henry Holt & Co., 1907. Pp. 15+315 with 125 illustrations.

Two years ago Professor F. E. Clements gave to advanced students of botany a very interesting and instructive volume entitled "Research Methods in Ecology," in which he marked out the field of plant ecology, described apparatus and methods of experimentation and of recording observations, and discussed the terminology of the subject. This has now been followed up by a textbook "based largely upon 'Research Methods,' but containing matter new or re-written" and adapted to meet the requirements of undergraduate students of the lower years.

As to the plan of the book, as stated in the preface, "the plant is first considered as an individual, with respect to factor, function, and form, and then as a member of a plant group of formation." The author's point of view is that physiology and ecology are essentially the same, and that a study of the vital activities of protoplasm, or of the living organism should properly be merged with a study of the living plant in its relation to the factors of the habitat and its adaptations to these factors.

It need scarcely be pointed out that Professor Clement's view is not the orthodox one. Pfeffer in the introduction to his Pflanzenanatomie maintains that description of the relations subsisting between the plant and its environment, or its struggle with the variable and external conditions presented to it" lies quite outside the province of a textbook of physiology. Ecology, or bionomy is clearly defined as "the sum of our knowledge with regard to the vital economy of the plant, and its relations with, and adaptations to, its dead and living organic and inorganic surroundings," and tersely by Haeckel (Systematische Phylogenie) as the "principles of plant economy."

Whatever may be thought of the author's creed, there is no question however, as to his enthusiasm, and his book will be wel-

comed as a distinct addition to our useful elementary text books of botany that deal with the subject of ecology.

Chapter I, on irritability in plants serves as a brief introduction to what follows. Chapters II and III deal in a very suggestive manner with the water of the habitat, and with such physiological matters as absorption, conduction and transpiration in which little new is presented. That an exact and statistical study of the physical factors of the habitat should be emphasized is highly to be commended. Chapter IV deals similarly with light. Chapter V, the least satisfactory of all is given over to a brief exposition of Respiration, Nutrition, Growth, etc. Purporting to be a textbook of Physiology, one cannot help express the view that such important phenomena are all too superficially and briefly expounded. Chapter VI is entitled "Adjustment to Gravity, Contact and Shock." The two succeeding sections are purely ecological, dealing with adaptations of plants to water and light, while the third is philosophical, a chapter on Evolution.

The remainder of the book is given over to an account of plants as members of plant groups or formations and is well done. Methods of studying vegetation, the plant formation, aggregation and migration, competition and ecesis (establishment of migrating plants), invasion and succession, and alternation and zonation are discussed in turn with a freshness and enthusiasm that give character to this latest addition to the ranks of elementary botanical texts.

J. H. F.

Traité D'Exploitation Commerciale Des Bois. Vol. II. By Alphonse Mathey. Paris, 1908. 835 pp., 429 plates. Price, 20 frcs.

This second volume adds over 800 pages, profusely illustrated with explanatory cuts, to the 488 pages of Vol. I, making probably the most ambitious work on Forest Utilization.

While the first volume was devoted to timber physics, including preservative processes, and to logging methods, this volume discusses the saw-mill practice and the application of wood in the arts and industries. The author does not only record the prac-

tice but is full of suggestions as to improvement of the practice, and especially as to uses of various woods now neglected. He criticises indeed, the inefficiency in the use of wood at home, although viewing the matter from our usage here it would appear most efficient.

The book is most profusely enriched with tabulations, and cost and price questions occupy much of the discussions.

The volume is divided into eight books, each sub-divided into chapters. The first book is devoted to cordwood and its uses for fuel, charcoal, pulp and other fibre uses. The second book discusses small dimension material, used in turnery, inlaid work, and posts, poles, props, etc. The third book treats the measurement and classification of logs, and the utilization and classification of barks; the fourth with lumber ready for use, and railroad ties. The saw-mill practice is treated in the fifth, cooperage and other split ware in the sixth book. Small wooden ware—the small forest industries—fill one part of book seven, and the great industries a second part. Finally, the eighth book discusses the by-products, tan, cork, naval stores, distillation. While, to be sure, the work is written entirely from the standpoint of French usage, by a French forester, and would perhaps, not interest the average American forester, no teacher, or especially investigator in the subject of forest utilization can afford to overlook this work, written in lively style. Especially as the time for more careful and intensive use of wood in our own country approaches will the value of this volume increase.

B. E. F.

Utilization of Wood Waste by Distillation. By Walter B. Harper. 1907, pp. 156, 20. St. Louis Lumberman, St. Louis, Mo. Price, $3.00.

Next to fire, the difficulty of disposing of the enormous wood waste which especially in virgin mixed woods forms the larger bulk of the contents is the greatest hindrance to satisfactory reproduction, especially to natural regeneration. Indeed these two impediments go together. If the wood waste could be removed, fires would not be half as detrimental. Hence any development of methods for using the inferior wood materials must be con-

sidered a boon to forestry not only from the economic but also from the silvicultural point of view.

It is rare that a trade paper produces contributions even to technical literature which have more than ephemeral value. Mr. Harper's articles on the utilization of wood waste by distillation is a distinct exception and the St. Louis Lumberman deserves credit and is to be congratulated for its enterprise in publishing, now in book form, such a treatise of permanent value. The work, while mostly a compilation, is done with the proper scientific spirit and at the same time with due regard to the practical questions. Especially the financial aspects are taken care of. This is the more to be commended as this essential condition of success is so often overlooked by those who are concerned only in the technical possibilities.

Unfortunately from the forester's point of view, the author confesses, that no economical or successful method of utilizing the waste in the forest, even of pine and fir has been developed—and the outlook is not promising. It was such use we had in mind when speaking of the subject of waste in relation to reproduction in the forest, but our hopes aroused by the broadness of the title of the volume were disappointed, for it deals after all only or almost exclusively with the distillation of pine wood, refuse at mills and especially selected in the woods. The practical utilization of the enormous hardwood forest waste is still an unsolved problem, except its limited use in expensive wood alcohol plants.

To give an idea of the contents of the volume we may give the headings of the thirteen chapters into which it is divided, namely: Introduction; Historical Connection; from which we learn that wood distillation dates back to the beginning of last century; Principles of Distillation; Apparatus necessary for destructive distillation; Refining Methods; Special Combination of Apparatus; Execution and Processes; Refining Processes; General considerations for the establishment of plants; Composition of wood and products of distillation; Yields and Disposal of Products; Chemical Tests and Combinations; Chemical Control of Plant.

The chapters on apparatus and processes are fully illustrated and occupy over half the space of the book.

B. E. F.

Jahresbericht über Veröffentlichungen und wichtigere Ereignisse im Gebiete des Forstwesens, etc., für das Jahr 1906. Frankfurt, 1907. 100 pp.

This annual report, which is published as a supplement to the Allgemeine Forst-und Jagdzeitung is a most valuable index to the literature in the field of forestry and cognate subjects. The field is divided into nine sections, each being reviewed by a specialist. Unfortunately, Germans have not yet learned the construction of a good index. To find out what has been published on any given point it is necessary to do much hunting through the pages with greater chances of missing the reference than would be the case if the clearer latin print were used. Naturally the references are mainly to German literature, although an attempt is made to include some French and English publications. Nevertheless it is a valuable work indispensable to any one who would keep *au courant* with the development of the profession.

B. E. F.

OTHER CURRENT LITERATURE.

A Key to the Genera of the Native Forest Trees and Shrubs of Indiana, based chiefly upon Leaf Characters. By Stanley Coulter and Herman B. Dorner, Lafayette, Ind., 1907. 24 pp. Price 20 cents. A new edition, including the shrubs.

Farm Weeds of Canada. By Geo. H. Clark and James Fletcher. Published by Department of Agriculture, Ottawa, 1906. 106 pp. 2° 56 plates. This unusually well illustrated volume with colored plates includes, of course, the common weeds of the Northern United States. Besides the latin and various common names and a description, the time of flowering, method of propagation occurrence by localities, the injury it does, and the remedies are given.

Forest Planting Leaflets, (U. S. Dept. Agr., Forest Serv. Circs. 76, pp. 3; 77, pp. 4; 82, pp. 8; 83, pp. 3; 84, pp. 4; 85, pp. 4; 86, pp. 3; 87, pp. 4; 88, pp. 5; 89, pp. 4; 90, pp. 3; 91, pp. 4; 92, pp. 4; 93, pp. 4; 94, pp. 3; 95, pp. 4). These leaflets treat

of the form and size, habits and growth, economic uses, methods of propagation, planting, cultivation, and care of the following species of trees, which are given in order corresponding with the circular numbers above: Silver maple *(Acer saccharinum),* Cottonwood *(Populus deltoides),* Hardy Catalpa *(Catalpa speciosa),* Russian Mulberry *(Morus alba tartarica),* White Ash *(Fraxinus americana),* Slippery Elm *(Ulmus pubescens),* Boxelder *(Acer negundo),* White Willow *(Salix alba),* Black Walnut *(Juglans nigra),* Tamarack *(Larix laricina),* Osage Orange *(Toxylon pomiferum),* Coffee Tree *(Gymnocladus dioicus),* Green Ash *(Fraxinus lanceolata),* Yellow Poplar *(Liriodendron tulipifera),* Black Cherry *(Prunus serotina),* and Sugar Maple *(Acer saccharum).*

Proceedings of the Society of American Foresters. Vol. II., No. 1, July, 1907. Contains the following articles: Some Philippine Forest Problems, by R. C. Bryant; Striking Features of the Forest and Water Situation in California, by E. A. Sterling; Some Problems in Hawaii, by Ralph S. Hosmer; Some Problems in Forest Education, by Henry S. Graves; Object and Methods of Establishing Permanent Sample Plots, by W. D. Sterrett; A New Explanation of the Tolerance and Intolerance of Trees, by Raphael Zon; Forest Fire Insurance in Germany, by Samuel J. Record; A Rough System of Management for Reserve Lands in the Western Sierras, by W. B. Greely; Some Government Timber Sales in the Southwest from the Practical and Technical Standpoint, by T. S. Woolsey, Jr.

Silvical Leaflets Nos. 1 to 14, U. S. Forest Service, 1907. These comprise Alpine Fir, Port Orford Cedar, Engelmann Spruce, White Fir, Lowland Fir, Sitka Spruce, Nobel Fir, Red Fir, Incense Cedar, Bigcone Spruce, Yellow Cedar, Western White Pine, Western Larch.

Report of the Pennsylvania Department of Forestry for the years 1905 and 1906. Harrisburg, Pa., 1907. 149 pp.

Twelfth Annual Report of the Forestry Commission of Minnesota for the year 1906. St. Paul, Minn. 149 pp.

Twelfth Annual Report of the Forest, Fish and Game Commission of New York. Albany, N. Y., 1907. 209 pp.

Fifth Report of the Forest Preserve Board of New York. Albany, N. Y., 1907. 35 pp.

Annual Report of the Superintendent of State Forests of New York. Albany, N. Y., 1907 . 39 pp.

Prolonging the Life of Mine Timbers. By John M. Nelson, Jr. Circular No. 111, U. S. Forest Service ,Washington, D. C. 22 pp.

Use of Dead Timber in the National Forests. By E. R. Hodson. Circular No. 113, U. S. Forest Service, Washington, D. C., 1907. 4 pp.

Wood Distillation. By W. C. Geer. Circular No. 114, U. S. Forest Service, Washington, D. C., 1907. 8 pp.

Second Progress Report on the Strength of Structural Timber. By W. K. Hatt. Circular No. 115, U. S .Forest Service, Washington, D. C., 1907. 39 pp.

The Waning Hardwood Supply and the Appalachian Forests. By William L. Hall. Circular No. 116, U. S. Forest Service, Washington, D. C., 1907. 16 pp.

Location, date of Latest Proclamation, and Area of the National Forests in the United States, Alaska, and Porto Rico. U. S. Forest Service, Washington, D. C. Oct., 1907.

Pflanzenphysiologische Studien im Walde. By Max Wagner. Berlin, 1907. 177 pp.

PERIODICAL LITERATURE.

In Charge:

Botanical Journals ..... R. T. Fisher
Foreign Journals ..... B. E. Fenrow, F. Dunlap, R. Zon
Propagandist Journals ..... H. P. Baker
Trade Journals ..... F. Roth, J. F. Kummel

FOREST GEOGRAPHY AND DESCRIPTION.

Slavonia's Forests.

The characteristic features of Slavonia's forests, according to Martin, are the extent of the old stands of nearly pure pedunculate oak, the volume of marketable wood they contain, and the size of the trees. Forest conditions, either physically or economically, are far from what they should be. The stand is open and the soil occupied too largely by undergrowth; nearly all the trees are stag-headed, due only to their extreme age. The increment is less than 40% of the normal, the stock about 35%, while there is almost no approach toward a proper distribution of age classes. Most of the area is occupied by over-matured trees and the young growth has lacked nearly every care that should have been given it.

Natural regeneration alone is practiced. The area is closed to grazing and the undergrowth of adventitious species is removed. After the mast has fallen the entire stand is removed at once and a thicket of brush springs up. Under this protection, which is heavy enough to be an impediment, the young trees grow, kept alive by the rich soil, and at length break through and overtop the thicket. The stands so produced are very uneven and some form of gradual removal of the parent stand extending over several years would give better results. But the management in Slavonia is extensive throughout and, on the whole, fair results are attained.

Stumpage is sold in large lots after careful estimates, usually to French or German syndicates owning large saw mills in the neighborhood. The price is very high and firm, giving best evi-

dence of the strength of the market for large amounts of oak. The best grades of oak are worth 3½ times as much as the corresponding grade of ash, and 5 times as much as beech of the same grade.

Slavonia's forests cry out against unthinking conservatism in forest management. Here the observer is impressed more than anywhere else with the foolishness of retaining, as a definite policy, old stands past their prime. The conditions in the stand go steadily downward from bad to worse and the prospects for return to the proper distribution of age classes and to normal accretion are pushed farther into the future. As a warning against over-zealous conservatism these forests well repay study. The forester can best apply to the soil whatever conservatism is in him. Stands require a century for their growth and finally must be renewed, soils once exhausted renew themselves more slowly still, if at all.

Mitteilungen über die forstlichen Verhältnisse in Slavonien. Zeitschrift für Forst-und Jagdwesen. Pp. 719-727. Nov. 1906.

Swedish Forest Conditions.

At the International Agricultural Congress, at Vienna, Dr. Anderson explained why Sweden was so favorably located for forest exploitation, pointing out that the number of drivable streams and their water conditions are so favorable for transportation from stump to ocean, as in no other country. Twelve large rivers of an average length of 200 miles each traverse the entire forest area of 50,000,000 acres (48% of the whole country), and some 30 shorter rivers of 60 to 120 miles in length, add to the transportation means in the lowlands. The fall in these rivers varies from 5 to 8 feet per mile, the most favorable for driving and rafting. The harbors are free from ice for six to seven months, and the ice in the rivers breaks up at the mouth first, also a favorable feature. Precipitation at 3,000 feet altitude is 900 mm, at 5,000 feet altitude 3,000 mm, 70 to 80% of which is carried off by the rivers, as against 30% in Middle Europe, giving rise to good spring floods which carry the wood from the small to the main rivers. The total length of rafting waters is about 12,000 miles, and to each mile 3 to 6 square miles of forest.

In 1865 the transport of logs, 12 to 30 feet long, cost between 6 and 7 cents; in 1902, about 3 cents for a distance of around 120 miles.

Centralblatt f. d. g. Forstwesen. October 1907, p. 436.

FOREST BOTANY AND ZOOLOGY.

Measurement of Light Requirements

The importance of the different requirements of light by different species and their relation to other factors like water absorption and transpiration has, since Gustav Heyer, been fully appreciated by silviculturists although only empirical data without any exactitude have been at the basis of the classification into tolerant and intolerant species.

The well known physiologist, Wiesner, attempted 15 years ago to determine more accurately and numerically the light requirements, and devised an improvement on the Bunson-Roscoe method of measuring light (Photometrische Untersuchungen, Vienna, 1893), which others have also followed, in which a chlorsilver paper is exposed until the color changes to a constant tone of a scale. Actually this is only measurement of the chemically active rays of the light.

Dr. Cederbaur, of the Austrian Experiment Station, has through two years tested the method and has found it inadequate.

The first question to be settled is, which light rays are required by the trees—the quality of the light—before the quantitative determination can be of value. It has been demonstrated that the chlorophyll in the single leaf has selective power. Referring to Frauenhofer's spectrum, the maximum absorption lies between the lines *B* and *C* (red), considerable absorption takes place at *F* (blue) and at *G* (violet) and *H* (indigo), while at *C* and *S* (orange, yellow) the absorption is small. The degree of absorption varies with different leaves and the number of leaves above each other; a sunleaf of the beech absorbs much more than a shade leaf. Exposing a spectroscope under a uniformly close each other; a sunleaf of the beech absorbs much more than a beech stand absorbs different rays from an oak or a pine stand. All absorb red rays, between *B* and *C*, also rays at *F* and towards

H, but in different degrees. The light-needing pine and larch absorb very similarly in red, blue, and violet, while the shade enduring species, spruce and beech, absorb blue and violet more strongly than red, and also some yellow. Ash and oak stand between these extremes and allow considerable quantity of indigo rays to pass through.

To determine the quantity of the different kinds of rays absorbed, a rather crude spectral photometer was used, in which a benzine flame, with a range of not over 500 meter candle power, served as standard of comparison. While absolutely the figures may not be reliable, the author claims at least relative value for the measurements. They show that the tolerant species absorbed nearly 10 times as much of the red rays than the intolerant.

For example the measurements of one day with cloudy sky may be given, the numbers referring to units of the spectrum of the benzine flame permitted to pass through.

	red	*orange*	*yellow*	*green*	*blue*	*indigo*	*violet*
Picèa excelsa, ...	2	7	12	100	40	200	100
Pinus silvestris, ...	150	200	470	500+	500+	500+	200
Larix europaea, ...	50	80	90	250	200	500+	100
Quercus pedunculata, ...	24	100	100	100	150	250	50

From all measurements it appeared that spruce, fir, beech absorbed strongly in red, blue to violet, while pine, larch birch absorb less of these rays and very little of indigo. A pine, therefore, overtopping a spruce leaves it very little red light but much blue and indigo which the spruce is able to utilize. A spectrum below a fir or spruce reproduction under larch or pine becomes very poor in red, blue, indigo and violet, the light being sifted a second time by the undergrowth.

Altogether, red rays are absorbed most intensely, green least so, blue and violet somewhat less than red, except by the shade enduring species which also absorb indigo and yellow.

The author having demonstrated the method, and that the quality of the light must be taken into consideration, expects with an improved apparatus to furnish the definite data for a classification of the species.

Das Lichtbedürfniss der Waldbaüme und die Lichtmess methoden. Centralblatt f. d. g. Forstwesen. Aug., Sept. 1907, pp. 325-330.

Heartwood Formation.

Investigations on over 2,000 trees of Scotch Pine by Pilz have developed the manner in which heartwood formation progresses in this species, and probably some more general laws of this process. The practical value of the investigations is readily understood when it is considered that heartwood and sapwood differ greatly in technical value. The durability of the former is well known, and Gayer points out that it is in direct proportion to the intensity of the color, and "since heartwood is superior to sapwood in nearly all properties, the amount of heart in the total wood volume is of moment in the sale value."

The tabulation shows that the heartwood formation begins early, below the 30 year; that the number of sapwood rings at the butt remains larger than those of heartwood to old age (at 230 years the relation is 83 to 150); that heartwood rings form a per cent. of all rings up to the 65 years of 29%, from 70 to 95 years of 39%, from 100 to 150 years of 44%, over 150 years 56%. The following unexpected results were had.

The countings from different sites, provided a large number was averaged, did not show great differences, but on the same site within the same age class, especially in old trees (over 100 years) showed great variations. In one case the variation was from 32 to 89, in another 43, 46, 47, 50. The progress of heartwood formation is not the same in all parts of the tree, the number of sapwood rings at the top is smaller than at the butt, *i. e.* the change takes place in younger wood earlier than at the base. The average of 214 trees showed sap to heart 60 to 42 rings at the butt, 36 to 28 rings at the top, that is, 24 rings which were still sapwood at the base were already heartwood at the top. Even 1 *m* above the butt a similar increase in heart is noted, so that while in young trees, at the base 25% of the rings lie in heartwood, at 1 *m* 33% are heart, and in old trees the relation is 33% and 50%.

Measurements on 761 of 115-year-old pines showed in the average at the base 178 *mm* sap and 279 *mm* heart, or 37 per cent. of the cross section, at the top 93 *mm* sap and 173 *mm* heart, or 42 per cent. of the cross section. The analysis of a tree from meter to meter, showed that the maximum of heartwood formation lay between 4 and 12 m above the base cut, varying here

between 35 and 44 per cent. of the cross section, while below it sinks gradually to 22 per cent., and above to 14 per cent.

The cause of heartwood formation is still an open question. It is known that the heart does not participate in water conduction, the cells being dead and certain materials, coloring matter, tannins, etc., being deposited in lumen and wall. It is likely that the more water is required the less tendency to heartwood exists. There being a relation between water requirement and transpiration, it is to be expected that broad crowned trees form less heart than small crowned, those on warm sites or open stand where transpiration is rapid form less than those in humid sites or dense crown cover, unless the influence of light tends the other way.

Incidentally the author refers to the importance of such a study with a view of finding out how to influence heartwood formation. Germany produces 1700 million cubic feet of wood of which 700 million is workwood. In addition, in 1906, she imported 476 million, mostly workwood of high quality, 86% of which is coniferous. Not only quantity but quality of production needs to be considered.

Einiges über die Verkernung der Kiefer. Allgemeine Forst u. Jagdzeitung. September 1907, pp. 265-272.

SOIL, WATER AND CLIMATE.

Forest Influences.

The Russians have lately given much attention to the investigation of forest cover in relation to hydrologic conditions and have come often to negative results. Under the title of Principles of Forest preservation, Wysotzki discusses in the organ of the Russian Forestry Association the relation of forest cover to water conditions adversely, based largely on Russian "discoveries." We know now, he says, that forest growth pumps its needs of water from great depths and preserves moisture only near the surface. Hence it lowers the ground water table, and hence also the water level of streams during summer, although this effect is reduced in mountainous regions. Its influence, therefore, is useful only in preventing the run off of rain water; as regards the moisture that has penetrated the soil it

can only be detrimental. Hence the hydrologic role of the forest must be judged in each single case. A general judgment is impossible.

The deterioration of waterways, which is ascribed to devastation at the headwaters, is to be credited not to a diminution of the running waters but to denudation, broadening of stream beds and filling them with the wash and debris from the deforested parts.

The ideal cover for dry rocky sites with dry climate is, the author claims, a gravel or rock debris with sand and soil underneath which holds the moisture.

Sand areas do not increase their water contents by being forested, on the contrary, the large entirely bare sand wastes, other things being equal, carry the most water. Their dryness is only on the surface. Only their denudation and filling up of river beds from their wash are detrimental. Hence forest and brushland should be kept along the river courses and wherever on account of the slope soil washes are likely.

As regards the influence on the humidity of the air, by the fact that the forest pumps up water from the depths and retains a large amount of precipitation, it increases transpiration and cools the atmosphere.

This is undoubted for the forest interior. But this effect is soon dissipated in the open. In a moist climate and for small countries like Sweden, according to Hamberg, the influence is almost *nil*, only for large continents like Siberia, the influence on the humidity of the climate is acknowledged.

Yet the author admits that the forest conditions of the North German plain, of Denmark, southern Sweden, of the Russian West Provinces, must be of real significance for the vast Russian interior plain and even for a part of Central Asia and Siberia, and he draws the conclusion that forest preservation has for Russia only a meaning in the cited West Provinces.

The influences on temperature and winds are also minimized by the author, and altogether the conclusion is reached that forest influence is by no means as potent as has been claimed. The author relies, to be sure, only on his philosophy without bringing new data, and in the subsequent discussion was charged as de-

sirous to promote a toning down of the existing laws of forest preservation.

Lesnoj journal. Allgemeine Forst u. Jagdzeitung. September 1907, pp. 318-320.

Forest and Winds.

The windbreaking effect of forests is probably one of the most evident forest influences, but has rarely been studied carefully. St. Murat, director of the Meteorological Institute of Roumania has made a special study of the retarding effect of forest growth on wind velocity. He finds that at 500 meters about (1640 feet) the effect is lost, that at 50 to 100 meters the retardation may amount to 4 to 7½ miles an hour, varying of course according to the initial velocity of the wind; after 100 meters the velocity again increases until it is re-established at 500 meters.

Annals of the Roumanian Academy, 1907. After Science. October 1907, p. 518.

Forests and Rainfall.

Earlier studies of the influence which forest cover exerts upon rainfall have been reviewed in these columns again and again. Data for the provinces of West Prussia and Posen have now been worked up by Schubert and are here summarized. Further work has been carried on in Liberia, and Swedish data are introduced and shown to agree closely with results obtained in Prussia. Correlating these three series of data it may be stated generally that at altitudes under 500 meters an elevation of 100 meters increases the rainfall 8-12%—the higher figure for the drier region—while in a country averaging 15-25% forest an increase of 10% in the forested area gives a corresponding increase of 1 to 2% in the rainfall.

The data from West Prussia and Posen were obtained as usual from paired stations one within, and the other the same distance from the edge of the forest in the open field. When summarized such data show that a rain-guage 1 kilo-meter within the forest registers not more than 1to 2% more rainfall than an instrument in the open 1 kilometer from the forest. This is the upper limit and carries with it the error due to wind.

Wind tends to reduce the amount of rainfall measured by a guage and the same is true to greater extent of snowfall. Taking advantage of this difference the author proposes to use the ratio of the additive correction to be applied to an exposed guage during rainy weather to the further additive correction to be applied during snowy weather as a measure of the influence of wind. This ratio he finds pretty constantly equal to 0.17+0.04, the variation being due to wind velocity. In this way the upper limits of the excess of rainfall measured in forests is reduced further until the excess itself becomes problematic.

Comparisons of the methods of measuring the influence of winds on the behavior of rain guages with guage measurements checked by anemometers shows satisfactory agreement.

Wald und Niederschlag und die Be-einflussung der Regen-und Schneemessung durch den Wind. Zeitschrift für Forst-und Jagdwesen. November 1906, pp. 728-735.

Forests and Rainfall.

Although the result of the observations at seventeen comparative stations in forest, forest edge and in the open, of the rainfall through five years in the Letzlinger forest showed the greater precipitation in the forest and the least in the open, Dr. Schubert points out that this does not show an influence of the forest, for the observed difference in the catch of 5.2 per cent. is compensated by corrections for snowfall and for difference in exposure of the gauges as regards wind, in other words the probability of error is about equal to the apparent difference in amount of precipitation.

The influence of wind on measurement of rain and snow in gauges was made a special study furnishing the correction factor.

Der Niederschlag in der Letzlinger Heide. Zeitschrift f. Forst-und Jagdwesen. August 1907, pp. 509-513.

SILVICULTURE AND PROTECTION.

Silvicultural Tenets.

The aims of silviculture with regard to the production of large increment and good quality has been a subject for discussion by authorities at the International Agricultural Congress at Vienna last May. It is worth while to brief the wis-

dom expressed in the form of referee's findings, to show that many silvicultural questions are still unsolved, even in the fatherland of forestry.

The question whether pure or mixed stands are preferable, according to Schwappach, is still an open one, the friends of the mixed type prevailing in the literature, while in the practice pure stands gain more and more ground. The attempt to grow mixed forest according to recipe is usually a failure. The cause of the frequent failures lies in the fact that the stands are not tended according to the original plan. Often a few years neglect suffice to turn a hopeful young mixed growth into an open branchy pine stand, or the most beautiful oaks in a spruce stand into thin spindling poles.

Regarding even-aged and uneven-aged stands Schwappach very properly declares, that the selection forest is, to be sure, the natural form, but a well managed selection forest is a very labor-intensive form, which requires of the manager a high degree of intelligence, and the most accurate knowledge of local conditions, almost of every single stem, a requirement which is probably rarely attainable. Moreover, he asks whether the evenaged timber forest does not produce as much or even more than the selection forest.

Speaking of artificial and natural regeneration Schwappach warns against the exaggerated partiality for natural regeneration, which is to be forced like a kind of legerdemain even under unsuitable conditions. On the other hand he warns against false economy in plantations.

Reuss, who advocated natural regeneration, admits that in general this method is quite unreliable and in many cases not satisfactory from the standpoint of a sustained yield. But in artificial regeneration stress must be laid on securing good seed material from healthy vigorous trees, ripe and properly kept. Regarding planting he uses the following significant language:

"Objected to on account of its obvious disadvantages, often maligned on principle, often much discredited through various misapplications and failures, the method of planting has after all everywhere victoriously conquered recognition as the surest prop of rejuvenation, the *ultima ratio,* to which the manager every-

where turns when natural regeneration and sowing has left him in the lurch. Especially where any difficulties of soil are encountered, planting becomes the sole sovereign of the field, and, in spite of all resistance of theory and practice, it stands to-day, untouched and unassailable, the most important and most widely used form of reforestation, which, if correctly executed, is capable of securing sound and thrifty stands, which as regards volume and value production equals, nay excels, any other form of regeneration. To be sure, planting calls for considerable knowledge and care, much more than is usually given to it. It sounds perhaps absurd and unreasonable but is correct and important to demand that planting, an act of force *par excellence* composed of unnatural operations should, as far as possible, conform to nature's demands, if the disadvantages and dark side are to be successfully overcome."

Regarding the further tending of stands by thinnings, the speaker rehearses the accepted rules that during the period before the culmination of height growth the crown-cover be little interrupted. Frequency, rather than degree of thinning, is important. When the first object, good, clean shafts of proper height, is attained, severer thinnings are indicated to secure the maximum of diameter increment. Since, with age and increasing crown diameter, the removal of any member makes a considerable break in the crown cover, the return of the thinning comes in longer intervals, and since violent changes produce undesirable response in the ring growth to the detriment of wood quality the thinning should after all be slight. He advocates the selection of an élite predestined to become the final harvest which, by an annular opening of the crown cover, can be developed in the most desirable manner.

Another speaker bringing in the field of statistics and questions of market, pointed out that the wood exports of all export countries had doubled in the last 20 years; that Germany in the last 40 years had quintupled its import of wood, while the production of the home forests had in the last 70 years increased only by two thirds.

Centralblatt f. d. g. Forstwesen, October 1907, pp. 382-387.

Cultivation of Sand soils.

In an article which breathes the woodsy flavor of a practitioner lacking academic precision, Schenk v. Schmittburg describes the troubles of growing pines in the poor sands of the Main valley, in which some academically accepted theories are being disturbed.

Not only is the soil a poor diluvial sand but the locality is one of the most rain-poor of Germany, especially in summer, insect pests abound in the dry situation, especially June bug and Tortrix species, game is abundant and damaging young plantations, labor too expensive and hardly obtainable. Thirty year old plantations, when clearing followed by sowing was practiced, seem to show that conditions then were not as bad as now. For successful planting under these conditions the author advocates two methods of soil treatment, namely removal of the soil cover and deep plowing. "Here in our sand—I should perhaps say: in spite of our sand, the loosening of the soil cannot be deep enough; only, it soon becomes too expensive." The author, therefore, places special value on baring of the surface, which not only allows more rain water to penetrate but also utilizes the dew. These advantages outweigh the disadvantage of the insolation, which, after all, dries out only the surface. To further benefit from the larger moisture supply below, the plants are set deeper than usual, even shallow rooted spruces are placed with the roots hanging down, which physiologically appears wrong: the first need is to start the plant, later it can secure the horizontal spread of the root system.

The labor trouble is such that machine work becomes necessary—the use of two plows, one following the other immediately, the first a surface plow with disk coulter knife close before the nose of the plow to prevent roots from catching the latter, followed by a subsoil plow of similar construction. A double plow combining the two functions is not as serviceable.

With these plows broad furrows are opened and either stout plants are set or seed is sowed in the furrows. The success of the latter method, namely sowing, has, contrary to expectations, given excellent results, better than plantations and sowings executed in different manner.

The amount of seed used per acre was rather plentiful, namely 12 lbs. to the acre mixed seed of Scotch Pine, White Pine and

Spruce in proportion of 10 : 2 : 2. The cost of this method is of course, less than planting, but, the author states, cheap methods have no value under such conditions.

Erfahrungen über die Kiefernkultur in dem Diluvial sand, etc. Allgemeine Forst u. Jagdzeitung, October 1907, pp. 339-346.

Silvics of Ash.

A long series of trial plantings conducted for 40 years on various soils with the European Ash may be of interest, as in some respects this species resembles our own White Ash. The results of the observations are formulated by Neumann as follows: The best silvicultural success is attained on the overflow lands of natural water courses, on fresh to moist, loose, permeable humous to peaty soil. To be avoided are impermeable soils, or those with impermeable subsoil, heavy clay and loam, as well as poor thin sand soils, too wet and sour soils, and frosty situations. Ash is not fit for pure plantations, where it soon ceases to grow and permits the soil to deteriorate. Nor is it fit to mix it with other species in rows, where the same unsatisfactory conditions as in pure stands result, even when a number of rows of the admixture is placed between two rows of Ash. The rapidly growing Ash with a spreading habit is apt to suppress the admixture entirely. It is, therefore, best used in single specimens or very small groups within groups of oak, beech, and Black Alder. On account of its liability to frost and the usually dense sod on soils where it thrives, it should be planted in larger sizes and a soil cover by underplanting of shadier species be provided. The volunteer growth in the neighborhood of old mother trees can be very well used either for transplanting in nursery rows or into the woods.

Another speaker doubted the advisability of artificial cultivation, leaving to natural regeneration the propagation of the species, which takes place readily wherever old seed trees exist.

A third speaker doubted the necessity of providing an under growth, because Ash "loves a sun warmed foot," and "a volunteer undergrowth establishes itself mostly under it."

Pommerscher Forst verein. Allgemeine Forst u. Jagdzeitung, October 1907, p. 364-5.

Know Nothings in Germany.

It appears that among German foresters the same misplaced patriotism has prevented an earlier and more persistent effort to introduce exotic species into German forestry, which has characterized the attitude of some of our compatriots in such matters. John Booth, the veteran nurseryman, who has labored for years for the introduction of exotics, has found that in 1820 the University of Heidelberg offered a prize for an essay on the value of introducing foreign species. This essay which secured the prize, whose author has remained obscure, named—*86 years ago!*—the very species which in 1901 were declared by Schwappach to have proved their right to recognition by the experiments began nearly 60 years later. In 1721—just 100 years earlier—Reaumur in France had made precisely the same recommendations without making any impression. Even to-day there is considerable opposition to the use of exotics, based on ignorant conservatism.

Die Universität Heidelberg und die ausländischen Holzarten. Allgemeine Forst-und Jagdzeitung. August 1907, pp. 279-282.

Practice in Thinnings.

According to Rave it has been at a relatively recent time that German foresters departed from the thesis "the more volume-capital the more increment" and recognized the new truth that smaller volumes may afford not only larger increment percentages but even increments of larger volumes. The present tendency is to increase the yield by increasing the value and amount of the thinning, and by increasing the value of the main crop even to the extent of diminishing the volume. Under the supervision of the experiment station at Eberswalde numerous sample areas throughout Prussia are being regularly thinned in accordance with carefully elaborated plans and accurate data kept of the results of the special treatment given each plot. The lines along which progress is promised have been indicated by the forest officer under whose direct supervision this work has been done. These are roughly as follows:

In young stands of beech, cut out all wolf trees where there is

any chance for nearby trees to fill the gap. There had best be no choice made during the earlier thinnings of trees to be held for the final crop. The earlier thinnings are solely to relieve the stand, so far as possible, from injury by its own too vigorous members. The effort should be to give no individual an advantage but to grow a stand of young trees of even size, height and crown development, which means even vitality. Removal of over-vigorous trees as soon as they appear never results in injury to such a stand.

Older stands which have not received such care earlier can not be so treated. Here care must always be taken to further the growth of certain trees which are by this act selected for retention until the final cut.

All suppressed beech is usually to be held in young stands and removed later so far as its value permits; but there are exceptions to this general rule depending on density of the stand and quality of the site. On very rich limestone soils, where beech thrives best and seed-years are frequent and heavy, it is well to retain suppressed growth throughout the life of the stand to prevent premature, undesirable regeneration after thinning. When suppressed growth is absent as is the case in most stands grown under past practices special precaution must be taken to destroy this adventitious growth before actual regeneration of the area is attempted, and to this end the method of thinning must often be varied.

The treatment of oak during the early years of its growth follows closely that outlined for beech, but greater stress is placed upon the need for retaining suppressed trees in order that the boles may be kept clear and the production of water sprouts held in check. Water sprouts are always found in pure stands of oak but the proper use of beech as a second story keeps the oak clear. In pure oak forests advantage is taken of the growth of water sprouts and a second story of suppressed trees is produced by allowing some of the weaker individuals to become overtopped and stag-headed before a thinning is made. Abundance of light then makes a new crown from water sprouts that have covered the stem, while corresponding sprouts on the stems of the main stand are killed by the full crown overhead. Attempts at under-plant-

ing mature stands of oak are not usually satisfactory. For the best results the beech must be of the same age as the oak, must be carefully cut back and kept out of the upper crown level and must not be removed until the oak itself is removed.

When thinnings have reduced the number of trees per acre to twice what the number is to be in the mature stand, definite choice is to be made of that half of the number to be retained and no effort spared to favor these. At this point the immediate end in view in removing trees from the stand changes radically. No tree is removed which does not interfere with one of these selected trees and every tree is removed that does so interfere. In the best stands choice must be arbitrarily made between neighboring trees exactly alike in every way. There may be some hesitancy about removing one tree to make place for another no better, but the increment justifies the removal in every case.

With spruce or pine a second story as undergrowth is not required, for these trees clear their boles readily and protect the soil sufficiently. Only on poorer soils and in the case of Pine is under-planting (with beech) for soil protection sometimes advisable late in the life of the stand.

On better sites forests of either species are rendered more productive by severe thinnings: this is especially true of spruce. The increment varies directly as the living crown surface in which assimilation takes place. In dense stands the crown cover is smooth; severe thinning fills this smooth surface with cuplike depressions so that its area is greatly increased. At the same time the increment is more valuable, being distributed over fewer stems. A concurrent advantage is that this breaking up of too dense stands renders them firmer against wind and against snow pressure.

Uber Durchforstungen von Laub-und Nadelhölzern. Zeitschrift für Forst-und Jagdwesen. November 1906, pp. 736-748.

Non-parasitic Diseases.

Forest plantations in reclaimed heather land in Prussia have to contend with adverse soil conditions in middle and later life as well as in the first year of their growth. Deep cultivation and proper measures for rendering the humus

in the soil available for tree growth may result in marked thrift in the early life of the stand. From observations on spruce at Lübberstedt it is evident, says Graebner, that during the middle life of the stand, or even later, the untoward soil conditions remedied at planting time may set in again and result in the death of the roots by suffocation.

At first the main roots strike deep into the soil and grow vigorously. Year by year the litter collects and does not readily decay in the damp climate; the soil is covered more deeply and freezing is prevented. In this way an agency active in maintaining healthy soil conditions is removed. The soil becomes almost impervious to air and is at the same time farther removed from the action of air by the thick cover of wet litter above. Finally the deeper roots die outright some season when the weather emphasizes the unfavorable soil condition in which they are growing. Under the continued influence of these conditions the lateral roots which remain alive grow on their upper sides only, forming narrow, board-like plates.

When the deeper roots are small as when the change in the soil is gradual, the tree may tide over the crisis and live on, supported by the lateral roots. In the opposite event it succumbs.

The effects on the tree both in appearance of crown and foliage and in minute structure, the growth and decay of the elements at the base of the stem and in the roots is described in detail. Determinations of resistance offered by soil samples to the passage of air were made and are here recorded. Damp raw-humus which was slowly pervious to air under pressure of half-a-meter of water became entirely impervious when packed firmly.

In and under heavy soil covers of moss and litter enormous pseudolenticels develop on the bases of coniferous stems and by the failure of the secondary corky growth of the stem to extend across them, entrance is given to injurious fungi and serious damage results. In a number of instances the mycelium of the root-rot *(Polyporus annosus)* was detected in these pseudolenticels.

Measures to remedy stands suffering from an accumulation of litter may easily go too far and result in immediate death of the diseased stand. Removal of the raw-humus is indicated but must

be done either in strips or in patches only, and not over the whole area at once.

Beiträge zur Kenntnis nichtparasitärer Pflanzenkrankheiten an forstlichen Gewächsen. Zeitschrift für Forst-und Jagdwesen. November 1906, pp. 705-719.

Insects and Smells.

That insects are sensitive to certain smells has been long recognized and used to keep them from doing damage, but that they are also attracted by other smells and influenced by them in their biological relations seems to be a new discovery by the Russian, S. Golowianko. His observations refer to the May beetle (June beetle), the larva of which is so destructive underground to young pine plantations. The author finds a relation of its occurrence to the existence of undecomposed humus materials, on which it feeds exclusively during the first year of its underground life. The female is attracted by the smell of humus to deposit its eggs, just as *Coprophagae, Arenicolae,* etc., follow smells. White sand remains unmolested, but plantations in sinks of gray soil succumb. On soil, only recently covered with grass, the beetle does not lay eggs, altho the rootlets would furnish good feed. The more humus a soil contains, the stronger the smell, the more attractive it is to the beetle.

Smell is decreased by shade, either of litter, weeds or stand, increased by humidity and by insolation.

A large-sized, open area—a cut—because of the increased insolation and consequent smell, attracts beetles more than smaller areas. The burning of the soil increases the smell and is attractive. On the other hand buckwheat smell is objectionable; smoke also; charcoal pits are avoided. Since it is possible to increase the humus smell on certain areas and thus to attract beetles, this may be used to keep them from more valuable areas and to bait them. To do this the areas must be tolerably large, kept without vegetation and furrowed or hoed before the beetle flies.

The attempts to reduce the damage of the beetle by growing grain in the infested areas for some time to reduce the humus, the author believes to be good policy, although experiments have

failed to produce results, which has been due to the manner in which they were conducted.

Lesnoj Journal, 1906. Allgemeine Forst-u. Jagdzeitung. September 1907, pp. 320-21.

Spraying against Damping-off.

In discussing means for preventing 'Schütte" or damping-off at the Pommeranean forestry association meeting, it was accentuated that to be effective spraying must be done at the right time namely, when the fungus spores are being sown, which is in July and August. The proper mixture of the copper-lime liquid can and should be controlled by the discoloration of curcuma paper.

MENSURATION, FINANCE, AND MANAGEMENT.

Influences on Increment.

An interesting contribution to the question of the influence of exposure and altitude is contained in a series of measurements on over 6500 firs (*Abies pectinata*) by Usener, which probably express at least the relationships for other species on similar sites in a degree.

Relying upon diameter measurements of trees 60 to 200 years old, the south exposure showed invariably the maximum development, then follow in descending order, east, north, west and plateau, without, however, any uniform regularity, from age class to age class. The differences between the first (*S.*) and last position (plateau) vary from 8 to 16 *cm*, the larger difference generally to be found in the older age classes. Similar increase of difference with age is found in other positions, the difference between South and East exposure varying from 0 to 15 *cm*, between East and North from 0 to 19 *cm*. The North sometimes showing, however, better diameters, as occurs also when West and North diameters are compared.

Diameter measurements classed by altitudes varying by 200 meters brought out the fact that the zone 400 to 600 showed maximum development, the diameter of all age classes decreasing, although only slightly, both at lower and higher altitudes. For instance the 90-year and 100-year classes show the series:

Altitude	*90-year*	*100-year*
200—400	40 *cm*	42
400—600	41	44
600—800	39	43
800—1000	35	38 *cm*

On a smaller number of trees a calculation of value increment was made which may not prove uninteresting.

The average 100-year old tree was analyzed as regards the sortiment classes and the six-year average of prices was applied, the periodical value as well as volume increment being calculated by the well known formula $\frac{M-m}{M+m} \parallel \frac{200}{n}$. The different classes of stem wood vary in price from 16 cents to 8 cents, split billets 3.2 cents, small round billets 2.8, and brush 2.5 cents per cubic foot. This makes the total value per cubic foot of the tree from the 50 to the 170 year change from 6.3 to 10.8 cents, or for timberwood alone from 8 to 12.8 cents.

Adding a calculation of price increase in the market based upon the actual increase for 20 years of 2.35% as the initial figure the following results were obtained:

Age	50	60	70	80	90	100	110	120	130	140	150	160	170
Volume per cent. (a)	3.1	2.7	2.4	2.1	1.8	1.6	1.5	1.4	1.3	1.1	1.	.9	.8
Value per cent. (b)	.8	.8	.7	.6	.6	.5	.4	.3	.2	.2	1.	0.	0.
Price increase per cent. (c)	2.4	2.3	2.2	2.1	1.9	1.7	1.5	1.3	1.2	1.1	1.1	1.1	1.1
a and b and c per cent.	6.3	5.8	5.3	4.8	4.3	3.8	3.4	3.	2.7	2.4	2.2	2.	1.9

These calculations refer, to be sure, to the single tree only, and with regard to whole stands they have value only as far as the increment per cent. of the single stem is a factor of the volume increase of the total stand, the stem number, or else the volume of the whole, being the other factors. Increment per cents of single stems and volume increment of stands often move in opposite direction. After a severe thinning the increment per cent. of the stem increases but the total volume increment is decreased. Moreover, in the mixed stands in question, the result of selection forest treatment, other difficulties arise, making a reasonable calculation of the increment per cent. of the over-mature stands hazardous. Yet, to get at least an approximation of the truth, a method had to be devised, by utilizing the measurements and figures for the average trees to the actual trees in the calipered

stands, leaving out all trees with less than 20 cubic feet corresponding to a diameter of 9 inch. It was found that there were then on the average just 100 trees to the acre with a volume of 8.475 cubic feet and a market value of $848, and an increment (volume+value+price) of $21.50. Making the comparison from decade to decade, with full realization of the difficulties in age determinations, etc., the author presents the following per acre tabulation:

Age	Stems No.	Volume Cu. Ft.	Value $	Increment (a, b and c) $	Per cent.
100	105	7,865	740	24	3.2
110	91	8,050	798	22.66	2.9
120	80	8,580	845	21.12	2.5
130	73	8,937	938	20.16	2.2
140	69	9,295	960	19.20	2.

The application is self evident. If rot does not do any damage the holding over of such old stands for reasons of management does not entail a great loss.

Zuwachsuntersuchungen an Tannen. Allgemeine Forst u. Jagdzeitung. September 1907, pp. 305-310.

Aims of Forest Management.

The aims and methods of regulating forest use—forest regulation—formed a subject for discussion at the International Agricultural Congress at Vienna, and, as usual, very divergent opinions were heard. Several speakers pronounced the principle of profitableness as the only tenable, or at least the prominent, aim. V. Guttenberg declared for such regulation as would secure the "highest" forest rent and a "satisfactory" interest on the capital represented by soil and stock, which could best be attained by the method of stand management, not however, confining the working plan to the next decade as Judeich advocates, but extending it to several decades. Stötzer on the other hand, advocating the index per cent. and a soil rent calculation as basis for the financial aim, considers the old schematic (Fachwerk) methods good enough.

A radical divergence of opinion was expressed by Kopetzky who also advocated the use of forest for grazing purposes under systematic regulation.

Where, he says, a population can only by the aid of forest pasture maintain the live stock necessary for a settlement, forest management must take this into consideration. Where it is in the interest of the state to favor the cattle industry in regions specially adapted to it, the most profitable use of the pasture must be balanced with the most profitable use of the forest, so as to make the total resulting income a maximum. Rise in prices of milk and meat products will force this policy. While in the last century the industries concerned in transforming, transporting and distributing materials have reaped the best recompense, the production of materials, which seemingly was only a means to an end, is bound to secure its reward, and forest regulation, a subject of national economy, must take cognizance of it. With the change of social forms, of human communal life, the aims of forest regulation must change.

Centralblatt f. d. g. Forstwesen. October 1907, pp. 438-440.

Problems of Management.

In that part of Prussia lying to the left of the Rhine, and more specifically between the Nahe and Mosel in the highest mountain masses of the lower Rhine, lie four forest districts forming a continuous forest area of 16,000 ha. (40,000 acres) extent. During the seventeen years between 1885 and his retirement in 1902 this area was under the supervision of Forstrat Otto Kaiser. His work has made its deepest imprint here in the splendid system of woods roads designed to render every part of the forest accessible to the highest degree, and no less to serve as a basis for a permanent system of subdivision for the area. Of this achievement we already have the report in two volumes, "Forest Subdivision" ("Eintheilung der Forsten") Berlin, 1902, and "The Technical Works of Subdivision" (Ausbau der wirtschaftlichen Eintheilungen) Berlin, 1904. Now we have a brief discussion of the more general problems these districts have contained, a review of historical development and, as always, a strong care for what the author believes, the true interpretation of the facts and the course of action they indicate.

Geological conditions and soil, silvicultural conditions and the condition of the game are taken up in detail.

The rocks are: above, Taunus quartzite bordered below with a talus of the same rock mixed with sandstone more or less weathered into a loamy soil. Third and lowest is a shale. Schist and sandstone outcrops and the soils, resulting from their weathering, occur in places. The upper formation is dense and carries little water, the soil, a light shallow sand, stony and dry and very poor, is absolute forest soil.

The lower talus and sandstone is richer in water and gives rise to numerous springs. Here the soil is heavy and stony; deep, fresh, and better adapted to tree growth than above. The lowest shale stratum yields a light, shallow, clayey soil, poor in lime and sand but rather rich in potash. Rock analyses are given so far as they have been made.

Beech and oak made up the forest in this as in the whole adjacent region. Growth conditions, especially in the poorer soils at high altitudes, give chance for but poor development. Though nature was once able to maintain forest growths of these species over nearly the whole area, human activity has so altered things that attempt at renewal fails. A change to conifers, to spruce especially, is clearly indicated, while the beech is to be retained in the lower altitudes wherever good soil and protected situation favor it. The oak must probably be dispensed with. This is a radical change from the importance which up to our author's coming had been attached to the beech and oak in this forest. Radical though it may be, only by this change can best results be secured.

The poorer quartzite soil of the higher ridges is fitted for nothing but spruce. It is even dubious whether under spruce an income can be depended upon; even so, some cover must be maintained and under spruce, soil conditions at such altitudes improve as under no other species. Soil conditions in the heavier loam zone next below are better; but spruce here makes excellent growth while beech thrives much less satisfactorily. There are islands of richer soil in protected situation and upon these beech may profitably be retained. The lowest zone made up of clay soils from shale rocks is hardly richer than the second, only the exposure is milder. More beech may be retained here, but still spruce should predominate as elsewhere.

Game was most abundant in this region in 1880. Under this

term are included first in order of importance the red deer, and in much smaller numbers the roe, and at an earlier date the wild boar. The wolf which, too, found harbor in these forests is now probably exterminated. The boar is much less plentiful than formerly, though during the past 30 years the average kill per year has been 400 head.

Early in the eighties the damage inflicted upon adjacent properties assumed such large proportions that the forest officers under ministerial direction and with the willing aid of the whole community enclosed about two-thirds of the state forest with a deer fence. The first winter after this work was completed was very open. The second winter, 1884-5, was one of the severest known, being equalled or approached only by that of 1859-60. Game suffered heavy loss in numbers and severe decline in vitality. The three winters following were but little less severe and the reduction game would otherwise have suffered was aggravated by the enclosure holding the starving animals at high altitudes. Hay was furnished as liberally as it could be procured, and every care taken but still the loss was severe. A large percentage were bucks of which the ratio was but one to three does at the time the fence was closed. The weakened deer were meanwhile attacked by botflies and loss every winter amounted to several hundred.

The inclosing fence is fifty miles long and cost in its day $9,000. It seems not improbable that the purpose could have been better attained otherwise than by this fence; but be that as it may the need for it has now disappeared and further maintenance at increasing cost, now that the structure is 25 years old, will be more and more unprofitable. The chase alone is sufficient to keep the stand of game as low as desired.

Forest conditions have suffered from the confinement of the deer. Young trees have had their bark torn away and heavy damage to whole stands has resulted, the final yield being reduced in amount and in quality. Young trees set out have suffered severely from browsing and plants coming up from seed sown have been eaten off by the acre. For the forest an unconfined range will bring nothing but advantages.

Finally hunting rights upon adjacent holdings will become more

valuable upon the release of the game within the inclosure. Thus the prime reason for the inclosure is removed and its maintenance, much more its renewal, at heavy expense is out of the question.

Beiträge zur Betriebs und Ertragsregelung der Wälder. Zeitschrift für Forst-und Jagdwesen. January, February 1907, pp. 21-44, 91-103.

Rotation and Thinning.

A simple diagrammatic method of explaining rotation and thinning and the net revenue of forest management and of showing the influence of changes in the first two on the third cannot fail to be of service. Schubert has developed such graphical representations of the methods of changing from one rotation to another, from one degree of thinning to another, and of the simultaneous change of both rotation and thinning over the whole as over a portion of the normal forest. The calculation of the differences in net revenue arising from these changes is also carried out and represented on a system of rectangular co-ordinates. These diagrams relieve the paper of much of the mathematical maze usually found in such discussions and make clearer the reasons underlying and demanding such changes.

Umtrieb, Durchforstung und Reinertrag. Zeitschrift für Forst-und Jagdwesen. January 1907, pp. 8-21.

UTILIZATION, MARKET, AND TECHNOLOGY.

Price and Change of Use.

The high price of certain woods in the English market forces users to seek for cheaper substitutes. The price of White Pine firsts fetching £34 turns buyers to canary colored whitewood. This new demand raises in turn the price of this commodity to from 3*s* 3*d* to 4*s*, and this price again makes former users of this wood look for the cheaper cottonwood as a substitute at 2*s* 6*d*, and "hazel" pine (Banksian?) at about 2*s* 3*d*. Scarcity of oak and proper grades are commented on, and oak shipped from Japan and Tasmania has begun to be a rival of the American, which is said to be poorly manufactured

under "slap dash" methods. "There are those among the prophets of the trade who do not hesitate to predict that it will be but a couple of seasons before the export of Pine deals from the ports of St. Lawrence will virtually cease," owing to a huge home demand. New woods find now ready consideration.

Canada Lumberman, October, 1907, p. 22.

Prepared Furniture Woods.

Black walnut which, until lately, furnished about 80% of the fine furniture in Germany, is being to a large extent superseded by native woods, oak, elm, birch, also pine and spruce. These latter, which are unsatisfactory in color, are first prepared in the following manner:

The freshly felled wood is at once placed in soil mixed with lime and other materials and left for 3 to 5 months, which imparts to the wood a remarkably fine color, so that it can be used without staining or painting. The color changes throughout and is supposed to be due to a change of the tannins. Moreover this treatment—the tanning of the wood—reduces or entirely cures the wood of its worst feature, swelling and shrinking, so that solid hardwood like beech may be used without fear from that source.

To reduce the liability to indentation, the springwood in conifers is removed by machines operating a kind of metal brush. Another method of using native woods for furniture is in cross-sections which furnish a durable face.

Centralblatt f. d. g. Fortswesen, October 1907, p. 368.

Cost of Logging.

Lately a sale of pine timber was made by the Ontario government on Georgian Bay, which brought $12.26 as a bonus for the right to cut, besides the $2 stumpage dues per M feet actually cut. It is calculated that the logging may cost $5 per M, towing $1, and sawing $3, making the total cost of production $23.26. To this is to be added a towing loss of 75 cents, and 6 per cent. interest on the money invested, which will make the total somewhere above $25 for the product on the market.

The Canada Lumberman, October, 1907, p. 20.

Wood Markets of Europe.

From a report of the German consul at Riga, interesting side lights on the wood market conditions of Europe are gleaned. Riga is one of the principal export ports, shipping during the last six years at the rate of around 48 million cubic feet. A stagnation in the business was noted in 1905 due to labor strikes and lack of log supply, but enough old stock on hand allowed a continuance of shipments to the amount of 46.5 million cubic feet. In 1906 prices rose "because shipments from America had been reduced, and the buyers in Western Europe had to a larger extent to look to Russia for supplies."

Allgemeine Forst u. Jagdzeitung. October 1907, p. 367.

POLITICS AND LEGISLATION.

Prussian Provincial Information Bureau.

It is well known that the remarkable industrial development of Germany in the last 30 years is due to the well organized educational and administrative systems. To foster the interests of agriculture and forestry in Prussia there were organized, since 1899 and later, in every province which desired it (now 8 or 9) one or more so called "Landwirtschafts Kammern" or agricultural information bureaus. These are entirely outside of the administrative departments. They are divided like our Department of Agriculture into divisions, the forestry division being one of them. Every seven years a report of the activity of these bureaus is made, which is as varied as the work of our department, the first of which reports (1901-1906) has just appeared.

The work of the forestry divisions can be classified under fifteen heads.

I. *Advice to private forest owners*, as consulting engineers for which the owners pay. The bureau in Brandenburg had in 1905-6 some 78,000 acres in 43 parcels of 1,200 to 5,000 acres each under permanent advice, for which a fee of over $2,000 was collected. The bureau in Posen had also over 70,000 acres under advice and the bureaus of other provinces smaller areas.

II. *Temporary or occasional consultations* were given in some

200 cases covering nearly 250,000 acres, also paid for. This usually ends in a permanent arrangement.

III. *Special technical expertise* and financial calculations in sales, divisions among heirs, estimates of stands, plantations, thinnings, cuts, etc., is also paid for, some hundred cases having been attended to.

IV. *Working plans,* just as is done by the Federal Forest Service, is a rapidly growing function of the bureaus. In Brandenburg of the 38 working plans called for, 26 involving somewhat over 50,000 acres were completed at a charge—a definite tariff exists—of $6,350. In Pomerania 45 working plans comprising 65,000 acres, in Posen, over 100,000 acres in one year were completed and smaller areas in other provinces.

V. *Wood Sales* with a view of a better use of wood materials and keeping owners informed as to market conditions or even conducting the sales. In Pomerania, for instance, sales to the amount of $230,000 were effected, the fee for which is 1 per cent. to cover expenses of scaling, valuation, advertisements and sales. Especially a combination of small owners is attempted to avoid the expense of many small sales.

VI. *Securing seed and plant material,* to protect the small owner from fraudulent practices. This service is given nearly gratuitously, including seed testing, guarantee from the seller, inspection of nurseries. Lower price is usually also the result so that the small fee added still leaves an advantage. In this the forest administration also aids with cheap plant material. The bureau of the Province of Saxony, in 1906, negotiated 9,200 lbs. of seed and 2,400,000 plants, of Pomerania in 1905, 25,000 lbs. worth $4,200, of Posen over 7 million plants and 8,000 lbs. of seed.

VII. *Reforestation of waste lands and poor pastures.* With regard to this work which is considered specially important the plan of the different provinces is not uniform. In Saxony the assistance is given to private owners, only when it can be shown that reforestation without aid exceeds the financial ability of the owner, and in the case of corporation work, which is considered a care of the State only when the subsidies from the State are not sufficient. Furnishing of plant material and only in rarest cases

of cash is the form of this aid. In no case is the assistance to be more in value than half the estimated cost (by an expert). The planting is done under supervision of the bureau, and a register is kept of all plantations. The applications must be made before September 1. A second subvention for the same plantation is not to be given. Care is taken not to furnish this aid for "luxurious" completion of plantations or for areas cut under the regular management. Especially associated efforts at reforestation are to be encouraged. The funds for this assistance come from the State Treasury and have not been sufficient to satisfy all applications. Yet in 6 years over 600 owners with over 2,000 acres received subventions of nearly 5,000 lbs. of seed and over 5 million plants to the total value of nearly $4,000.

In Brandenburg a special reforestation fund was started in 1902 by setting aside the income from the forest administration. Here the subventions are given mostly to corporations, municipalities and associations, some $2,500 so far. In other provinces the payment of money subventions is usual.

VIII. *Price quotations* for wood are collected and published, mostly weekly, which is also an advantage to the State forest and other forest administrations. These are distributed without charge.

IX. *Formation of forest associations,* not to discuss but to practice forestry, so-called Waldgenossenschaften, is encouraged, but, with the exception of Hanover, where 48 such associations with 7,500 acres have been brought into existence to secure the benefit of united action and uniformity of management, no success of note has been accomplished, and the desirability of trying enforced association by law is discussed.

X. *Mutual Fire Insurance.* This idea has so far not materialized. In 1901 a number of private owners in Brandenburg (mostly city corporations) were ready to pool nearly 200,000 acres and negotiations with a fire insurance were entered into, but the demand for an initial insurance fund of $750,000 prevented the arrangement. In other provinces the Munich-Gladbach fire insurance company is usually recommended, but since its premiums are still rather high, owners are usually advised first to use the money for better protection by fire lines, etc. The

proposition for the State to deposit without interest charge the desired security fund has not found acceptance.

XI. *Forest Loans* are made in Silesia and East Prussia by the admirable mutual provincial credit banks, separating soil and stand. This method has been found desirable because it was found that the forest owning farmer in need of funds cleared the very areas of forest soil, in order to secure on the new "farm" soil a higher mortgage loan.

XII. *Forest protection* is especially fostered in the direction of insect predations. The Posen bureau, *e. g.*, negotiated at low prices 65 pumps and 35,000 lbs. of copperas, for fighting the "Schutte," which has grown to dangerous dimensions. The cost of the work itself came to only 42 cents per acre with satisfactory results.

XIII. *Experimentation* is not yet much developed but assistance has been given in Saxony and Brandenburg, to determine value of manuring, and in introducing exotics.

XIV. *Employment agency.* Not only are proper contracts drawn between employer and employed, but efficient employes are recommended and to some extent their efficiency guaranteed. Some 32 foresters were employed in Pomerania through the medium of the bureau.

XV. *Education* is fostered through lectures and addresses before agricultural societies and short courses designed for owners and underforesters. A better education of the latter is attempted by sending experts of the bureau, as examiners, to the private foresters' associations and by employing such in the forest divisions. Brandenburg and Saxony support in part a private underforesters' school. In Hanover, of 19 lectures before the Agricultural Society, 18 were given in forest work with practical demonstrations in planting, marking for thinning, etc. Similarly the bureau of Brandenburg carries on regular courses.

This, in brief, and without exhausting all the activities reported, are the admirable and strenuous efforts to foster private forestry in a country which has been noted for over one hundred years for its State forestry.

Die Forstabteilungen der preussischen Landwirtschaftskammern. Allgemeine Forst u. Jagdzeitung. August, 1907, pp. 288-296.

Forest Taxation.

Just as in this country the principles of just taxation of woodlands forms still a subject for discussion in the old countries. A contribution towards this question was furnished in the following resolutions agreed to at the International Agricultural Congress, at Vienna.

1. The income from extraordinary cuts shall remain exempt if occasioned by natural accidents, even in intermittent management.

2. The income from forests under intermittent management is to be taxed separately from other taxable income.

3. Tax is to be assessed only on actual income, not on expected income.

4. Costs for new plantations of hitherto blank areas are to be deducted from the taxable income of the taxpayer.

5. In those states in which the soiltax (which is considered antiquated), is still in vogue, it is desirable to take measures for reducing its rigidity as far as possible, by ascertaining the net yield under consideration of surrounding conditions.

6. Favor in taxation is to be given to protective forests, tax exemption for new plantings, tax reductions in case of damage by natural agencies.

Centralblatt f. d. g. Forstwesen. October 1907, p. 436.

Forest Politics in Austria and Prussia.

In a thoughtful article Martin contrasts the policies of the two leading German countries. Few planting projects have attracted such wide attention as that going on in the Karst of southwestern Austria, both on account of the natural difficulties, of severe climatic conditions to be overcome, and because of the great political importance of reclaiming these devastated areas. Yet this very region, now being planted at such expense, but a few centuries ago furnished the lumber from which the fleets were built which made Venice the mistress of the seas.

The soil of the Karst is of limestone origin and the bed rock is hollowed out into caves, through which most of the rainfall drains away, so that the soil is extremely dry. Successful plant-

ing is impeded further by grazing privileges and by lack of protection against the sun, which is important in this warm climate.

Austrian pine succeeds best, with Corsican pine and other maritime species near the shore and Scotch pine farther inland. Larch and fir thrive in the higher altitudes. Broadleaved species, even the black locust, have not proven of any value. Planting of large, vigorous plants, with the addition of some rich soil in the hole, is the method chosen.

The political policy of non-interference, of *"laissez-faire,"* is responsible for the Karst. The direct causes are improper usage and pasturing by sheep and goats. In Austria-Hungary, the Karst covers some 230 square miles. This example of the extreme effects of a "do-nothing" policy, in forest protection, brings us to a consideration of the policies of different European states in this regard.

The states of southernmost Europe have adhered to this policy of non-interference with private interests in forest matters and have depended entirely upon private enterprise to maintain forest, where forest should be. The most northern states, Russia and Scandinavia, have until recently, followed the same policy. France, Austria-Hungary and Germany have on the other hand, recognized the state's duty to care for the interests of the whole communities, where they conflict with personal interests and of the interests of future generations, when the foresight of the present users of the forest threatens to fail. The degree of recognition varies. In this respect, as in her whole political history, France has had widest experience. Here and in Prussia, the policy of close supervision of private forests is steadily gaining ground, while in southern Germany and in Austria-Hungary, supervision in minute detail is already practiced.

The Prussian law regarding protective forests is not broad enough or far reaching enough. In trying to proportion the cost of establishing protective forests (and establishment must usually be by planting, which is in itself a disadvantage), too many factors are drawn into the consideration of each case and too great cost is laid upon the complainant who calls this law into use against an adjoiner. Besides, he must prove that the results to be expected will exceed the cost entailed, which, reasonable though it may look, does not permit of numerical proof.

The provisions of the Prussian protective forest law may be applied, (a) when drifting sand threatens injury to adjacent property, public property, rivers or canals; (b) when on steep slopes, public or private property below is in danger of being flooded with talus or landslip, or when a landslip threatens injury to property above the area in question; (c) when the forest in question directly protects the banks of a stream; (d) when removal of the forest would diminish the flow of a stream; (e) when removal of a forest would expose arable land to the deteriorating action of winds.

In Hungary protective forests are defined by ministerial proclamation as follows:

1. Areas lying at timber line upon which forest growth must be maintained to protect protective areas lower down.

2. The upper edge (strip 75 rods wide), of all forests extending to timber line.

3. Forests on steep slopes where clearing might lead to landslips, gullying, etc.

4. Forests whose sudden removal would seriously affect the productivity of adjacent fields or endanger public or other works.

These measures deal clearly with only such forests as are protective in the narrowest and most immediate sense of the word. There is a less clearly definable protection afforded by nearly all mountain forests and this has escaped attention for the very reason that the influence is so general and indefinite. Should extensive clearings be undertaken in mountain forests now outside state jurisdiction, the shortcomings of the law would be quickly noted. The definition of protective forests is not general enough. The remedy lies in determining, as is done notably in France, what forests are protective by careful study of local conditions and local tendencies in forest management, and extending the area of protection where excessive cutting makes it necessary.

The doctrine of full restitution, where private forests are proclaimed protective and subjected to state laws governing such, has impeded the extension of these laws. Though individual freedom may increase the recognition of the rights of whole communities has been less rapid. Historically, the protective forest law of 1876, marks the turning point in Prussian policy, the departure from the laissez-faire policy, adopted in 1811. This

law at first glance seems to have produced little result; there are less than 200 acres in Prussia now subject to its provisions. But indirectly, it has brought vaster results if we ascribe to it all the benefits the abandonment of the laissez-faire policy has brought. The state has other potent means by which its influence for good is exerted upon private holdings. By buying up and reforesting all sorts of waste lands, by controlling public and private corporations to holding forest lands, by levying fees for numerous privileges involving the use of public forests, and by actively determining the limits of various crops an immense amount of good has been done by the Prussian state. Higher wood prices, even for wood of the poorer grades, has tended to increase the forest area, especially in regions with a ready outlet to market.

Die Richtung und die Erfolge der Waldschutzpolitik in Osterreich-Ungarn im Verhältniss zum gegenwärtigen Stande der Waldschutzpolitik in Preussen. Zeitschrift für Forst-und Jagdwesen. February 1907, pp. 76-91.

NEWS AND NOTES.

E. A. Sterling, *In Charge.*

As a result of a resolution adopted by the 15th National Irrigation Congress, California will probably try out an entirely new policy as regards the control of lumbering operations on private lands. It is, in short, a plan to restrict timber cutting and to prevent the denudation of drainage basins at the headwaters of streams valuable for irrigation. Since most of these lands are privately owned it remains to be seen whether the State, through the office of the State Forester, can dictate to the lumberman the manner and extent of his cutting. It is simply a case of the minority (the lumbermen) being forced to sacrifice, for the sake of the many (the agriculturists). Precedent is found in State action which restricted, and eventually practically stopped, hydraulic mining because the debris worked injury to agricultural lands in the valleys and interfered with the flow of streams. In the case of lumbering operations, restrictions can probably be imposed, which will protect the irrigationist, and at the same time, permit the use of most of the merchantable timber on the important catchment areas. In connection with this action, or better preceding it, must come intensive fire protection. A carefully lumbered slope, if allowed to burn over, it will be little better as a watershed cover, than the scene of unrestricted cutting.

Reports from various parts of the country indicate that the seed crop of most species will be very poor this year. Mr. L. C. Miller, who has returned to Washington from two months in the field, where he has been personally directing seed collecting operations for the Forest Service, reports that practically no seed can be obtained in Southern California. The only places where collecting could be done satisfactorily were the Sawtooth, Henry's Lake and the Lewis and Clark National Forests. In these forests red fir and lodgepole pine were the only species which fruited heavily, although a limited quantity of Engleman spruce

seed was obtainable. In the East the chestnut crop was almost a total failure and the few nuts collected were held by dealers at from $9 to $12 a bushel. The production in the southern Appalachains was more plentiful, but few of the nuts reached the dealers. The crop of acorns was also light, although those who placed early orders for the more important species, will probably get them filled. In the Adirondacks white pine and Norway pine seed were fairly abundant, but it is reported that the crop in the Lake states, particularly of Norway pine, was very light.

Forest legislation in Pennsylvania made little progress at the last session of the Legislature, although the machinery for the enforcement of the State forest fire laws was considerably improved and rather rigid measures adopted to prevent forest fires on lands in which oil wells or gas wells are situated. This last Act provides for a close season each year from the 1st of April to the 20th of May and from the 10th of September to the 10th of November, during which time it shall be unlawful to burn fallows, stumps, logs, or debris of any kind in any forest lands on which there are producing oil or gas wells. Excepting during the close season named, fires may be set upon such lands by securing written permission of the local fire warden and by having him present when such fires are started, with other restrictions regarding setting fire during a strong wind, having help enough present to control it, and guarding it until it is entirely extinguished. Section 2 of the Act requires that any owner or lessee of forest lands under the above head shall at least once each year remove all brush and debris from within 100 feet of all wells or rigs and also all inflammable material within 100 feet of the right of way of any railroad company operating through oil lands. Section 3 names the duties of railroad companies in the oil country and requires them to keep their right-of-way clear and to take other measures towards preventing and extinguishing fires and makes them liable for damages to the owners of any property destroyed and also subject to a penalty of $100 for each violation of the Act. Although such legislation as that mentioned above is a step in advance, there still remains

the need for more systematic action which will give to the State as a whole an effective code of forest laws with the necessary machinery for their enforcement. The tendency seems to have been to pass rather too drastic laws covering minor points without sufficient co-operation between the Legislature and the Forest Commission to solve the main problem. The present unsettled condition as regards forest taxation for example is sufficient to discourage those desiring to plant or maintain forests, yet the partial solution which has advanced in the form of a new bill failed of enactment.

The Pennsylvania Railroad Company has decided to establish a new nursery near Morrisville, Pa., and will develop about 12 acres for this purpose. This change of results from the fact that the nursery near Hollidaysburg, Pa., was found to be too small and generally unsuited for a main distribution point and most of the work will be concentrated at Morrisville, where about 300 bushels of acorns and chestnuts will be planted or stored this fall, and a large amount of coniferous seed planted in the spring.

During the fiscal year 1907-1908, the investigation and study of the forest resources of the Philippine Islands will be made a much more important branch of the work of the Bureau of Forestry than in former years. The Division of Forest Products, organized last year to collect and place in an available form information concerning Philippine forests and forest products, has been enlarged and its name changed to Division of Forest Investigation. Three foresters and three rangers will devote their entire time to the work of this division.

Up to a little less than two years ago the collection of the taxes on forest products occupied nearly all the time of the forest officers, leaving little opportunity for forest investigations. The transfer of the work of collecting taxes to the Internal Revenue officials, however, allows much more time for purely technical work.

The division of Forest Investigation, as its name implies, will aim to secure and place in the most available form, information regarding the forest resources of the Islands. For the present

its principal work will be to locate and map the forest lands and to determine approximately how much and what kinds of timber can be secured from each place. This work will be done as rapidly as possible and large areas will be covered during the coming year. Detailed studies of the forests will be made in a few places, though mapping and exploration come first in the plans. When the location and character of the existing forests are determined, tracts suitable for modern lumbering operations can be designated, forests which should be protected can be reserved, and a definite forest policy can be outlined for the future.

Other lines of investigation will also be carried on. The most important of these will be a thorough test of different timbers for railroad ties and paving blocks. Only a few of the most valuable of the Philippine timbers are now accepted as ties, and it is highly important to determine what kinds of wood, if any, may be substituted for these. Tests will be made on a number of the most promising kinds.

The duties of administration will now be performed by a Division of Forest Administration having a field force of six foresters and about eighteen rangers. This division will attend to the licenses for the collection of forest products, to the inspection of lumbering operations, to violations of the forest laws and regulations, to the examination of homesteads, etc.

By this new division of labor it is believed that the work of the Bureau will be rendered much more effective and that better results will be secured. As far as possible each division will co-operate with the other to make the work of each more efficient.

Within the next few months, a comprehensive scheme of redistricting a number of the National Forests will be put into effect. The principal changes will occur in Oregon, Washington, California, Montana, Idaho and Colorado. Under the new plan, the administration of the Forests will, in many cases, be greatly simplified, by making divides or mountain summits the division line between administrative units, rather than valleys. As a result, a Forest Supervisor having headquarters in a valley town between two mountain ranges, will, in general, administer the slopes of each range draining toward his headquarters, rather

than both slopes of the same range of mountains, as previously. In this way, Supervisors will be enabled to keep in communication with their rangers all through the winter months, instead of being cut off by snow during a considerable portion of the year, as heretofore. The change will also be a great convenience for the users of the forests, who in the past have frequently found it impracticable to reach the Supervisor's headquarters in order to transact business with him, without going a long distance around.

During October a very profitable series of ranger meetings was held in Oregon and Washington. In California, similar meetings were held in November. It is planned to hold a series of ranger meetings and also a number of Supervisor meetings in Colorado and South Dakota during the month of February. In addition to rangers and Supervisors, these meetings are attended by Inspectors and by representatives from the Washington office. By this means the efficiency of the field force is very greatly increased.

At the beginning of November, approximately 163,000 acres of agricultural land in the National Forests had been listed under the Agricultural Homestead Act, approved July 11, 1906. A large force of examiners has been engaged all through the past field season in making examinations of lands under this Act, and when the reports are all received and action taken, the total area listed for entry will have reached a sum considerably in excess of that named. Lands in the National Forests for ranger headquarters or other administrative purposes are not listed under this Act but are withdrawn from all forms of entry for the permanent use of forest officers. Cabins and pasture fences have been constructed during the past season on a large number of sites thus withdrawn.

In addition to the $500,000 set aside by Congress for the construction of permanent improvements on the National Forests, $100,000 has been set apart for the same purpose, by the Forest Service, from its regular appropriation. Practically the whole $600,000 has been allotted to the various Forest Supervisors, and the money will be expended by the close of the fiscal year, June

30 next. Of this amount, a large sum has gone for the construction of telephones, and the balance principally for roads, trails and cabins, and for pasture and drift fences. Through this expenditure the administration of the National Forests will be greatly simplified. This, however, marks but the beginning of the improvement work which must be carried on in the Forests, and it is greatly to be hoped that Congress will see fit to make an appropriation this winter for its continuance during the fiscal year 1909.

Upon recommendation of the Forest Service, there have been withdrawn from entry, in western and northwestern Arkansas 1,421,120 acres of public land, for the proposed Arkansas and Ozark National Forests. It is expected that final action with regard to the creation of these Forests will be taken some time during the early months of 1908.

Early in November, the total area of National Forests in the United States, Alaska and Porto Rico reached 161,633,894 acres. The total number of National Forests was 162. Of the area named, practically thirty-five million acres were added within the preceding twelve months. Under the terms of the amendment to the Agricultural Appropriation Act, no further forests or additions to existing forests can be created, without special Act of Congress, in the states of Oregon, Washington, Montana, Wyoming, Idaho and Colorado. Just prior to March 4, 1907, the date on which this Act was to take effect, proclamations were signed by the President adding approximately seventeen million acres to the National Forest area. This included within permanent reservations practically all the remaining Government timberlands in the states named, in which the percentage of alienations was not too high to render administration impracticable. It is probable that no further additions will be made to the forest area in these states. Some comparatively slight additions are, however, contemplated in other states and territories, for which temporary withdrawals have already been made.

During the month of October there were placed on the Wichita National Forest and Game Preserve fifteen buffaloes from the

New York Zoological Park, of which Dr. William T. Hornaday is Director. A high woven wire fence has been erected, enclosing the buffalo range, and every precaution taken in order that the animals may not become infected with the Texas fever tick.

The litigation regarding the status of the Cornell College Forest has proceeded on its dreary way through the first stages, with the result that the Appellate Court has ruled adversely to the contentions of the Attorney General that the Act establishing the College was unconstitutional and that it was unconstitutional for the State to purchase the tract and hand it over to Cornell University.

The litigation will now proceed on the ground that under the law prescribing the management under forestry practices the University exceeded its powers by making a contract for selling all the wood, or at least some of the provisions of the contract may for the same reason be invalidated.

The initial semester of the Forestry course at the Pennsylvania State College has opened with a very promising attendance and good prospects for a thorough course of instruction under Prof. H. P. Baker. Eighteen men are classified in the first three years of the course with a promise of five additional men at the beginning of the second semester. A new instructor will be appointed to the Department by February 1, 1908. A temporary frame building two stories high was built for the work last year. In it over 70 large specimens of the trunks of mature trees, exhibited at the Chicago Exposition, and nearly 200 small specimens collected from the 10th Census are installed. For a working library there are $300 worth of Forestry books purchased by Dr. B. E. Fernow, which with those already in the College library make a fairly large collection. In connection with the academic course, which calls for about 45 hours per week, special stress will be laid upon practical work, and as soon as arrangements can be made the men will be required to spend at least 4 weeks in lumber camps in various forest regions.

Notable progress in forestry has been made in Michigan in 1907, which may be briefly summarized as follows:

1. *Legislation.*—The following new forestry measures were passed:

a. A forty thousand acre tract in Iosco and Oscoda Counties was set aside from the lands owned by the Michigan Agricultural College, to be managed as a Forest Reserve by the Michigan Agricultural College.

b. The fire warden law of 1903 was abolished and in its place a law was passed making the game wardens forest wardens. Thus it is really a State-paid patrol. It is right in principle, but there is much criticism as to the details of the plan.

c. A law was enacted creating a special "Commission of Inquiry, Tax Lands and Forestry" which is independent of the permanent State Forestry Commission. The special Commission is a temporary body composed of ten members, non-paid but allowed all the means necessary to do its work. The personnel as appointed by Gov. Warner is of the very best and is non-political. It represents a variety of business activities and is composed entirely of representative citizens. The duty of the Commission is to report to the next Legislature the forest conditions and needs of the State, and to draft a set of forestry and tax laws. The report is to be printed and ready for distributtion by Oct. 1, 1908. The personnel of the Commission is: B. D. Graham, President, Grand Rapids; C. V. R. Townsend, Negaunee; Geo. B. Horton, Fruit Ridge; A. L. Palmer, Kalkaskia; Chas. B. Blair, Executive Agent, Grand Rapids; A. B. Cook, Secretary, Owosso; Francis King, Alma; D. B. Waldo, Kalamazoo; W. E. Osmun, Montague; Carl E. Schmidt, Detroit.

A bill to create a State Farm Forester was introduced and was very favorably considered. It was, however, withdrawn at the request of the friends of the Michigan Agricultural College, who claimed that this line of work could and would be attended to by the Agricultural College.

For the first time in the history of Michigan a special paragraph was devoted to forestry in the Governor's message.

2. *The Michigan Forestry Commission.*—The Michigan Forestry Commission is continued as before, except that Arthur Hill, of Saginaw, is replaced by W. M. Mershon, of Saginaw.

3. *The State Forest Reserve.*—During the fiscal year 1906-1907 over three thousand dollars' worth of dead timber was sold

from one of the two districts of the Reserve, while there was an expenditure of less than one thousand dollars, thus proving that the Reserve can readily be made self-sustaining and more. Over 60 miles of fire lines have been built. The fire patrol this year prevented all fires. The forest plantations, the nurseries, and the natural reforestation are progressing as well as could possibly be expected.

4. *Forest Schools.*—The Forest School of the University of Michigan, at Ann Arbor, gained fully 50% in attendance, the students in forestry now numbering over ninety men. The plantations of the Saginaw Forestry Farm, at Ann Arbor, are becoming a valuable object lesson not only for school and experimental purposes, but for the general public. These plantations are established jointly by the Forest School of the University of Michigan and the U. S. Forest Service.

The Forest School of the Michigan Agricultural College, at East Lansing, lost its Director, Prof. E. E. Bogue, by death. The position was filled by the appointment of Prof J. Frederick Baker.

5. *Private Forestry.*—The Cleveland Cliffs Iron Co. have increased their staff of foresters and are planning reforestation on a large scale. Hon. W. B. Mershon and associates are preparing for extensive reforestation of a tract on the Ausable River. John Newhall and Sons are carrying on good forestry work on Manitou Island. Nelson Mickelson, of Grayling, and R. Hanson, of the same place, are gathering up lands and making preparations to convert these into regularly managed forest properties. Hon. Carl E. Schmidt, of Detroit, is carrying on work in reforestation at Cedar Lake, Iosco County.

Application has been made to the Governor by lumbermen, offering to manage certain forest areas as regular permanent forest properties if the matter of taxation can be equitably adjusted.

6. *Distribution of Seedlings.*—The Forestry Commission distributed over 60,000 seedlings for experimental plantations among various land owners in the State.

7. *Public Sentiment.*—The forestry sentiment among the people, among legislators and with the press, is steadily growing. One of the best illustrations was the enthusiastic meeting of the

Northern Michigan Press Association at Traverse City, where, without any suggestion from "forestry enthusiasts," an entire evening was devoted to forestry, and reforestation was strongly advocated.

8. *Forestry Convention.*—A forestry convention was held at Saginaw, Nov. 12 and 13, 1907. Four sessions were devoted to the third annual meeting of the Michigan Forestry Association, an organization with between six and seven hundred members. Two sessions were occupied by an important conference of the forestry officials of the Great Lake States and Ontario, with the aim of bringing concerted action in the several commonwealths. Representatives were present from Ontario, Michigan, Wisconsin, Minnesota, Ohio and Illinois. Several resolutions expressing the opinions of the convention upon important forestry matters were adopted. It was decided that a committee consisting of one member from each state and province of the Great Lake region shall be organized whose duty it shall be to draft a set of forestry laws, which latter shall be submitted to the respective legislatures.

During the past summer wide-spread publicity has been given to certain tentative plans looking toward the control of the flood-waters of the Ohio River and its two main tributaries. Prominent dailies and other periodicals throughout the country have published news notes and editorials apparently inspired by some authority which do not hesitate to point out that the ultimate control of these floods depends upon forest plantings on a scale surpassing anything ever attempted on this Continent. The various articles in question point out that at least 2,000,000,000 trees must be planted and give the impression that this wholesale planting will prove an effective method of meeting the flood problem.

Just what authority there may be for these statements is not known, but it would certainly be interesting to learn what has been the basis for their publication. Competent observers, familiar with the area about the headwaters of these streams are of the opinion that forest planting could be of little benefit for the very obvious reason that there is comparatively little land which could be planted and in addition there are practically no

absolutely denuded areas. It is quite apparent that the statements given to the press were based upon a general theory rather than upon any proper examination of local conditions. Although the Pennsylvania forests at the headwaters of the Allegheny River have been wastefully exploited and it may be assumed in all probability that floods are more frequent and destructive as a result, it yet remains the fact that, in spite of the frequent fires, the cutover areas are at present covered with tree growth of various sizes and the problem there is one of forest protection rather than artificial reforestation. There is little doubt that it is of benefit to awaken a wholesome interest in forestry and to point out the advantages of well managed forest, but it is surely open to question that interest should be aroused by statements which trade on the lack of knowledge of the readers.

The Sprout Forests of the Housatonic Valley of Connecticut.

Fig. 1.—Chestnut Slope Type.

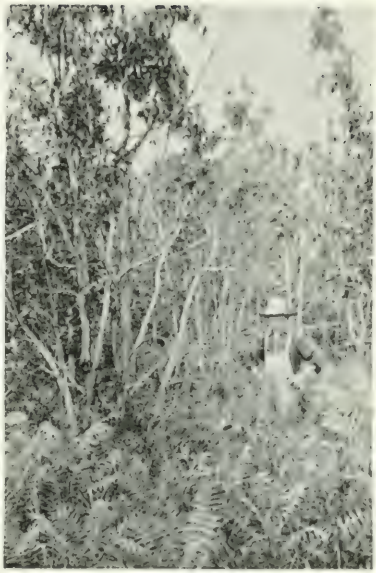


Fig. 2.—Oak Ridge Type.

Fig. 3.—Interior of a Mixed Slope Forest.

Fig. 1.—Shagbark Hickory Sprout with new, independent root system.
Stub of former tree at trowel.

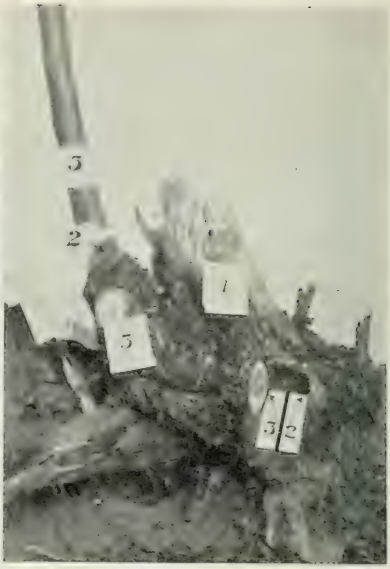


Fig. 2.—Stub of an Old Chestnut Sprout showing three generations.

Fig. 3.—Chestnut Sprout with Old Stub and two Decayed Roots (near middle) and New Root System (at right).

Fig. 4.—Parent Stock and Independent Root System (at right).

Fig. 1.—One and Two Year Old Seedlings taken from a Sprout Forest

Beginning at trowel: Two White Ashes, two Hard Maples, Pignut, two Shagbark Hickories, White Oak (four years old), Chestnut Oak, Red Oak

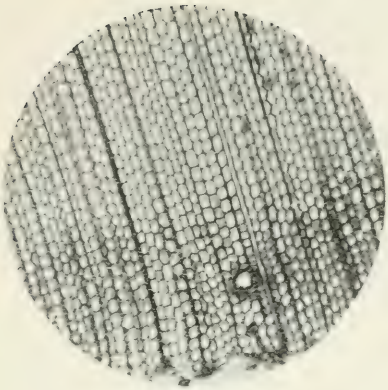
Fig. 2.—Seedling Sprouts.

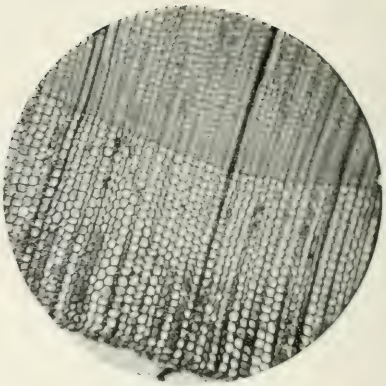
Beginning at left: Sassafras, Bitternut, Red Maple, White A

Fig. 1.—Underground stem of Pignut Hickory with sprout killed in recent surface fire, showing Fungus at Base, followed by two others.

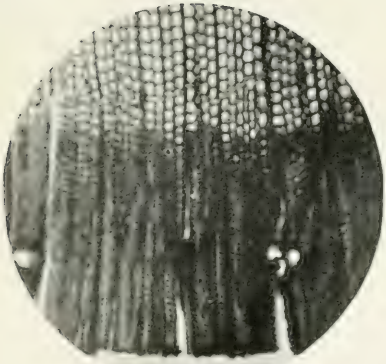
Fig. 2.—White Ash, showing recent sprouts and former sprouts (at left) burned in same fire.

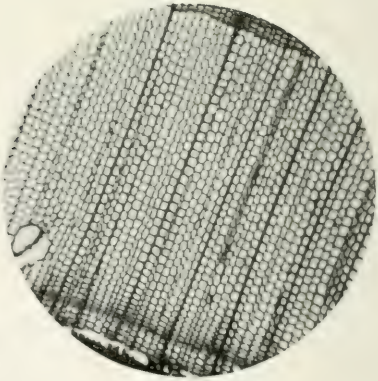
Fig. 3.—A Clump of Butternut Sprouts killed by fire.
Shows form of growth leading to accumulation of litter among the old, half-decayed stumps





June





December

Larch

White Pine

Cross Sections through annual ring of White Pine and European Larch in June and December

Rolling Screen for Nurseries.